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A Record of Disasters.

MONTH by month *Harper's Magazine* gives a tabular list of great disasters. The January issue, including reports from Sept. 18 to Nov. 11, mentions 10,000 deaths from flood in Japan; 50 deaths in Quebec from landslide; 50 in Naples from railway collision; 46 on the Mississippi from boiler explosion; 50 at Longton, Eng., in a colliery; 685 in Japan from a tidal wave; 33 at sea in the shipwreck of the "Bolan;" 40 in Glasgow from the collapse of a factory wall, and 500 whole families in China from flood. Yet there is not a word of any electrical death, when we know that during the same period, throughout the world, there were probably no fewer than five deaths from electricity. Something is wrong with the statistical bureau of *Harper's Magazine*. The editor must have been suborned. He surely cannot have read the lurid editorials in *Harper's Weekly* on the alarming character of electricity.

Transformer Phenomena.

THE discussion of the paper read by Prof. H. J. Ryan, on Transformer Tests, before the American Institute of Electrical Engineers serves to bring out strongly the fact that, notwithstanding the considerable progress made in the design of transformers and their adaptation to commercial work, there is still much to learn in regard to the various phenomena which take place in the cycle of their operations. As Professor Ryan's paper showed, differences of load have a marked effect on the character of the curves obtained. These curves, as the load increases, depart more and more from the ideal form which theory would assign. The causes which bring about this departure are well elicited in the discussion and afford a good indication of the direction in which future study and research will be turned. These will involve principally the magnetic qualities of iron, and hysteresis will probably play a most important part in them.

Standard Wiring Rules.

As announced elsewhere in a short note, the American Institute of Electrical Engineers has seriously taken up a subject which is of the utmost importance to every one engaged in the distribution of electricity for whatever purpose, and which is to-day unfortunately in a somewhat chaotic condition. By this we do not mean to say that wiring at present is not generally done by rules, but the rules in use vary so much among themselves, and, indeed, err in the majority of cases on the far side of safety, that uniformity would lead not only to more systematic practice but to economy as well. As stated, it is not intended to effect any radical departure from existing practice, as this would evidently be undesirable, but merely to bring together and co-ordinate what has been found to be the best in past practice. The Institute is eminently the proper body to undertake this work, in which it follows the example of the English Institution of Electrical Engineers and the Elektrotechnische Verein of Vienna.

Peculiarities of Alternate Currents.

EXTENDED as the literature of the continuous current is at the present, we believe that the time will soon come when it will be far exceeded by that of the alternate current. This is well indicated in the admirable address of Dr. W. E. Sumpner before the City and Guilds Old Students' Association, of London, on the subject of the peculiarities of alternate currents. Though taking up but a half dozen of these peculiarities, Dr. Sumpner shows that the inherent qualities of the alternate current give rise to an infinite variety of phenomena, but few of which may be said to have been yet to any degree developed. Any one of those pointed out might alone form the basis of experimental and interesting investigation, and the results which might be attained could not fail to be of practical value in many cases. We recommend to our readers a careful perusal of this most interesting address, as it describes a number of the most recent and remarkable phenomena discovered in connection with the alternating current.

"Killed At Grade."

No fewer than 34 citizens were killed in Philadelphia last year at railroad crossings on grade. The total of such deaths in the city at railroad grade crossings for the last five years is 189. In view of this fact the Philadelphians intend to abolish railroads, so far as their city is concerned. No road will be allowed to run into the city hereafter, but all must go around it; and passengers wishing to cross it must make the journey in horse cars. It has been suggested to the good citizens of Philadelphia that by raising some of the tracks, lowering others, and insulating all of them with proper guards, these accidents might be stopped, and the city still enjoy the advantages of high tension travel right into its very centre. But they will hear none of it. They point out that the 34 deaths in 1889 do not include those of railroad employés or those of tramps killed stealing rides, averaging at least one "accident" per day in the city limits. So they have done with railroads altogether, and hereafter Philadelphia will get along without them. Philadelphia is right, and we are glad to see all the New York daily papers approving its brave and intelligent decision in the matter.

The Reaction Against the "Ring."

A MOST decided reaction has set in against the ring or gang of political jobbers who are responsible for the recent wholesale and indiscriminate wire cutting in New York City. The local companies are struggling to give service as best they may, and throughout the city the demand is made for the restoration of electric light and power. The organ of the "ring," the New York *World*, however, says: "There is no great public inconvenience suffered by reason of their suspension. What there is is due to their obstinate refusal to use the subways. Their little game is to annoy the public till the public consents to help them in their scheme to get control of the Subway Company and speculate in its stock. The public will not be so coerced, and it is not to be fooled by any pretense set up by these old offenders. The gas lamps will soon be in place again, and if the electric companies persist in suspending business rather than go into the subways with their wires, other capital in plenty is ready to supply the city with electric light. The schemers may intimidate a merchant here and there, or bribe a newspaper writer of the baser sort to their service, but the public is not now to be trifled with. The wires are down and they must stay down." This intimation about the "other capital in plenty" is interesting, and it looks as though the cat had been let out of the bag. Cannot the *World* supply some more information as to the other capital that is so plentiful and so ready?

Testing Circuits.

THERE is no more important element in the erection of an electric wire circuit, no matter of what description, than the ascertaining of the integrity of the work as it proceeds. The laying of submarine cables involved such continuous testing, but for most operations in the running of conductors on land this precaution is in the large majority of cases entirely omitted or only improperly performed. This is unfortunately and particularly true of house-wiring for electric lighting, and the defects not infrequently lead to much trouble after a lapse of time. The testing magneto is probably still used very generally as an insulation tester, but it is manifestly only an indicator, and not a measuring instrument in the real sense of the word, as it gives but a vague knowledge of the condition of the circuit. The reason for its general use is probably to be found in the fact that it is simple in its operation; but beyond this it has nothing to recommend it. We are, therefore, glad to note the appearance of an instrument designed to meet the conditions both of simplicity and of accuracy. These ends seem to be achieved in the Evershed ohmmeter, described in another column, which allows of the direct reading of the insulation resistance in ohms. The retention of the magneto as the source of electric energy avoids the use of cumbersome cells, and has the additional advantage that it puts in the hands of the average wireman an instrument with which he is already perfectly familiar.

Magnetism or Adhesion.

AT frequently recurring intervals the daily press make announcements of the alleged wonderful "magnetic" qualities exhibited by certain individuals, who are able to make various substances adhere to their hands without exerting any muscular pressure upon them. The miscellaneous nature of the bodies which are embraced in the list of such adherents, embracing wood, glass, etc., would at once dispel the theory that magnetism, either "personal" or otherwise, had anything to do with the phenomena, but they are so rarely investigated with the object of reaching their true cause that an instance of the latter deserves attention. Such an investigation has, we note, been recently made by Dr. W. Simon, of Baltimore, which proves pretty conclusively that causes other than magnetism must be assigned to the observed facts. The subject examined was able to maintain by mere contact with the fingers, a weight of 2,500 grams; but it was shown that this power was exercised only on very smooth or highly polished substances, glass being the most favorable in this respect. The cause assigned by Dr. Simon to account for the observed facts, and which is probably the correct one, is the well known adhesion between two bodies brought into such close contact as to exclude the air between them, the pressure of the atmosphere acting to maintain the bodies in contact. It is, therefore, only a question of the smoothness of the skin, which would appear to be the qualification necessary to enable any one to manifest "magnetic" properties; indeed the experiments made show that this quality can be cultivated to some extent. As the experiments of Dr. Charcot, of Paris, have shown that hypnotic influence can be exercised by a piece of wood shaped and painted in imitation of a steel magnet, the above additional evidence of the non-existence of any real magnetic qualities in the human body will go far toward setting at rest any erroneous impressions which may still exist in the minds of some on this subject.

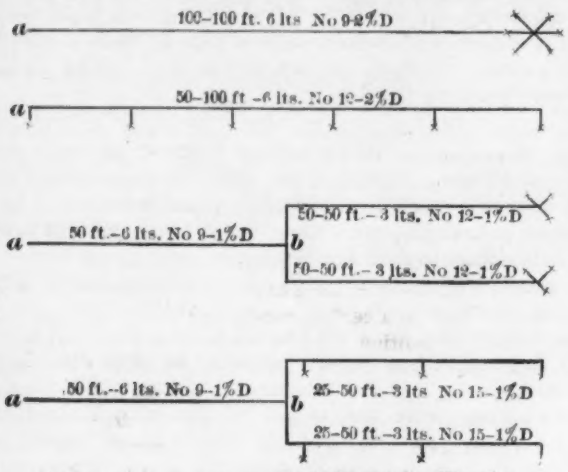
How it All Happened.

WE are very sorry to have to note the destruction by fire of the old Edison station in Pearl street, the first incandescent lighting central station in this country. It had not outlived its usefulness, but it was as much out of date from an engineering standpoint, as compared with modern stations, as the old wooden frigates are compared with the modern ironclad. There has been rapid evolution since 1882, and it seems but yesterday that our Edison friends were full of anxiety as to the result of their Pearl street work, all of which was so new and strange. It was, by the way, a two-wire station, and we assume that, when restored, it will be upon a three-wire basis. We note that the fire is attributed, though the assertion has been contradicted, to a short circuit on the mains. In explaining this to its readers, the *Evening Sun* states that under a short circuit a dynamo generates so much electricity that the current drops off in red hot sparks; hence the fire. But our well-informed contemporary should have given the whole of the theory connected with the intricate phenomena of short circuits. It well knows that in such circumstances the dynamo becomes preternaturally magnetic, so that if it stand on a wooden floor, all the nails in the planking are drawn out, fly to it, and then are rendered incandescent by the charge they receive; after which they drop off, it being a familiar fact that red-hot iron or steel loses its magnetism. Thus they may cause a fire. In the case of the big Edison dynamos at Pearl street, it is probable that their power was so great as to extract the iron bolts from the roof beams, and these bolts, falling on the machines and then flying off, might present the spectacle of red-hot sparks referred to by the expert of the *Evening Sun*. A short circuit is, we agree with that paper, an awful thing, especially when oil-soaked planks rise up in their amazement and cling to the overcharged dynamo, like so many love-sick maidens to a sighing Bunthorne. After all, life might be a dreary thing just now to electricians, if it were not for the cheer they derive from the newspaper theory of electricity.

The Eversheld Ohmmeter.

The idea of an ohmmeter, if we remember rightly, says the *London Electrician*, is due to Profs. Ayrton and Perry; but it has been left to Mr. Sydney Evershed to carry out its construction in a manner having the necessary practical and commercial qualities. The value of insulation tests made with a few cells has never been considered great—dynamo makers, in particular, being fully aware of the lowering effect which even the application of very ordinary pressures has upon the properties of insulators. The difficulty, however, of making tests outside the factory with high E. M. F.'s had stood in the way of reliable main and house-wire tests. But now that to a portable ohm or megohm-meter we have the addition of a portable 100 or 120-volt generator, we may look for better things.

In Fig. 1 is shown the complete apparatus, consisting of



FIGS. 1, 2, 3 AND 4.—INCANDESCENT WIRING.

a direct reading ohmmeter, graduated with a range from 10,000 ohms to five megohms, with an open scale and distinct figures. and a portable magneto-generator of special construction, enabling 100 to 120 volts to be obtained by turning the handle at the moderate speed of about 120 revolutions per minute. All that is necessary to measure the insulation resistance of any circuit is to couple the wires to be measured to the terminals, turn the handle, and the needle at once points to the number of thousand ohms or megohms representing the insulation resistance.

In Fig. 2 the connections of the ohmmeter and generator are shown diagramatically. The generator D and current coil C are connected in series with the mains M M, the insulation resistance of which is to be measured. The pressure coil P with a large resistance R is arranged as a shunt on the generator. The direction of the resultant magnetic field of the current and pressure coils depends on the ratio of the currents in them, and as the current in the former is $\frac{E}{r+x}$, where r is resistance of current coil, and x the insulation resistance of the mains,—and the current in the pressure coil is simply $\frac{E}{R}$, where R is the total resistance of the pressure coil and its series resistance, we see that the direction of the resultant field depends only on $\frac{r+x}{R}$. The needle system is either astatic or placed in a field reduced nearly to zero by means of a neutralizing magnet; so the position of the needle N.S. depends on $\frac{r+x}{R}$. The term r is eliminated in the process of calibration, each division corresponding to $(r+x)$, ohms being marked as x ohms. The position of the needle depends, therefore, only on the ratio $\frac{x}{R}$. As the current coil is traversed merely by the leakage current, its field is very weak, so that it has to be made of several thousand turns, and the needle brought as close as possible to it. The ohmmeters are usually made to read from five megohms down to 100,000 ohms on one scale, and the current coil is provided with one or two shunts to continue the range down to 10,000 or 1,000 ohms.

In addition to their use as ohmmeters, these sets of testing apparatus completely dispense with the lineman's detector and battery. The generator alone may be most conveniently used for continuity tests during the wiring of houses, etc., by keeping it connected to the main leads; and while it is being driven at a moderate speed, every pair of single-light leads is tested by making contact, and noting, by the sparking at the commutators, whether the circuit is intact. The whole process is exceedingly quick and certain. A short circuit at any point of the ramification can also be detected by the severe drag on the generator handle, and by the violent sparking at the commutator.

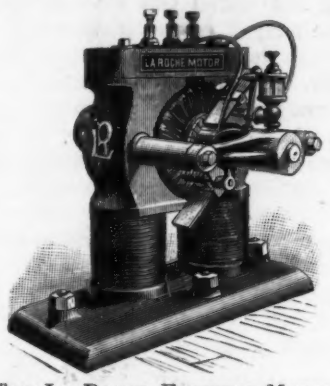
The whole apparatus is compact, well constructed, and neatly finished off, and should prove an indispensable adjunct to the equipment of any one engaged in the practical testing of insulation resistances. It is made by Messrs. Goolden & Co., of London.

FIGS. 1 AND 2.—THE EVERSHED OHMMETER.

The La Roche Electric Motor.

Our illustration represents the electric motor designed by Mr. F. A. La Roche, electrician of the La Roche Electric Works, of Philadelphia. The motor is compactly built and so designed that it delivers its power at one-half the speed usually employed. The magnet cores and armature are made of Norway iron, the whole resting on a cast-iron base.

Special care has been devoted to the brush holder, in which any rigid brush of carbon, graphite, or metal may



THE LA ROCHE ELECTRIC MOTOR.

be used, and so as to effect the least wear and sparking at the commutator and to insure absolute contact.

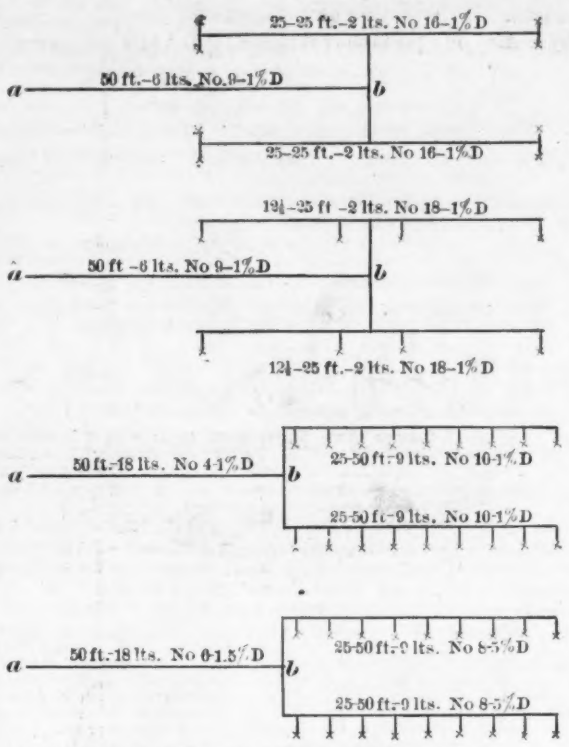
Incandescent Wiring.

BY A. H. ALLEN.

The writer has noticed in a recent issue of THE ELECTRICAL WORLD that a correspondent asks: "In calculating the size of wires in incandescent distribution, where branches are taken from the mains, is the same "drop" calculated in each branch, or divided between the number of branches? In other words, must the full "drop be calculated in every branch?" Believing correct wiring to be of the utmost importance to a successful installation, I take the opportunity of explaining fully the method I have adopted.

Let us assume that we are to wire for 50-volt 16 candle power lamps, requiring one ampère of current, or their equivalent in different candle-power lamps, at a two per cent. drop. The variable quantities determining the size of wire to be used will be *distance* and *number of ampères* due to the varying distribution of lights. But to make myself more clearly understood, by comparison, I will take the same number of lights and the same distance, in the following examples, which in practice will generally be found to be the elementary requirements of any particular case.

For simplicity of illustration, let us represent the circuit of two wires by one line, and the lamp by a cross (×). *a* is in each case the main vertical cut-out where the wires enter the building, and from which we are to wire for a two per cent. drop. The size of wire is determined by



FIGS. 5, 6, 7 AND 8.—INCANDESCENT WIRING.

reference to a Westinghouse 50-volt secondary table. Al wire is given Brown & Sharpe gauge.

Fig. 1 represents six 16 c. p. lamps, or their equivalent at a distance of 100 feet from the vertical *a*.

Fig. 2 shows the six lights evenly distributed along the same distance.

In Fig. 3 we run the main 50 feet from the vertical, then branch with three lights on the end of each leg of 50 feet.

Fig. 4 is the same as the last, except that the lamps are evenly distributed along each leg.

In Fig. 5 the main is run 50 feet, then branches twice with two lights at the end of each arm of 25 feet.

Fig. 6 is the same as the last, except that the lights are evenly distributed along the arms.

The writer has found it convenient, and has become accustomed to using two terms, but which he does not know of being used by others in this connection, namely, *centre of distribution* and *lighting centre*. The first is comprehensive in itself, and is used in the sense commonly employed. By the second is meant the centre, considering the *ampères per tap*, along the line from which taps are taken, and *need not*, necessarily, be the linear centre of that line. The distinction will be clearer by reference to the diagrams. In Figs. 1 and 2 there is no centre of distribution, unless it be considered coincident with the lighting centre, since there are no branches. In Figs. 3, 4, 5 and 6, the "centre of distribution" is at the first branch *b*. In Fig. 1 the "lighting centre" is at the end of line; in Fig. 2 in the middle; in Figs. 3 and 5 it is at the end; in Figs. 4 and 6 at the middle of each leg or arm, respectively.

What we are after is the average "drop," as unquestionably the lamp, Fig. 2, nearest the vertical would be at a higher voltage than the extreme lamp, varying in degree only by the "drop" taken.

Change of drop is easily obtained by remembering that, given the number of ampères, the drop is directly proportional to the distance and inversely to the circular mils of the wire; so that if one-half the drop is desired, one has merely to double the distance, and read the size of wire from the table, and vice versa.

The writer always makes diagrams of wiring similar to those here represented, and writes along each line all the data respecting that circuit; the linear distance on mains and on branches; also the distance to the "lighting centre," represented by the *first figure* given; the number of lights carried by that main or branch, number of wire and the drop. A copying book is kept for the purpose, the sketch

copied, the original given to the wire man, and all in convenient shape with least labor for future reference.

But it may be said that this takes too much time. Not half as much, if carried out with system and experience, as your wiremen are consuming in *discussing* the matter, and then, in nine cases out of ten, coming to a wrong conclusion. I always test and consider the wiring correct if, by means of a portable voltmeter, a difference of potential of one volt between vertical and "lighting centre" is obtained.

It is often convenient to vary the "drop" in mains and branches. It will be seen by Fig. 7 that a No. 4 wire is required on "main;" but by increasing the drop (Fig. 8) in "main," and decreasing it in the branch, the same result is obtained, with a more convenient size of wire for the main.

And thus we see that correct house wiring, generally either wholly ignored or done by thumb rule by ordinary wiremen, becomes a matter of knowledge, experience and discrimination. But some may say, Are you not making a mountain out of a mole hill? Decidedly, *No:* which I may emphasize by personal experience. The writer has in mind at the present moment a plant where the house wiring involved the critical question of profit and loss to the users. Improper house wiring had been done, resulting in a drop varying from four to eight per cent., which caused excessive lamp breakage. It was corrected on the lines herein marked out, and to-day the plant is a prosperous one.

The writer fully believes that the sooner the importance of this subject is realized and acted upon the better it will be for the incandescent lighting business and its advancement.

C. & C. Motor and Blower on the U. S. S. "Baltimore."

The new warships of our navy are being constructed in the most modern plan, and, among other innovations, special arrangements have been made for their thorough ventilation. All the new ships being equipped with complete dynamo plants, this problem has been very easily solved by the use of electric motors to operate ventilating fans and blowers. Our engraving shows the arrangement employed for ventilating the dynamo room of the U. S. S. "Baltimore," built by Messrs. Wm. Cramp & Sons, of Philadelphia.

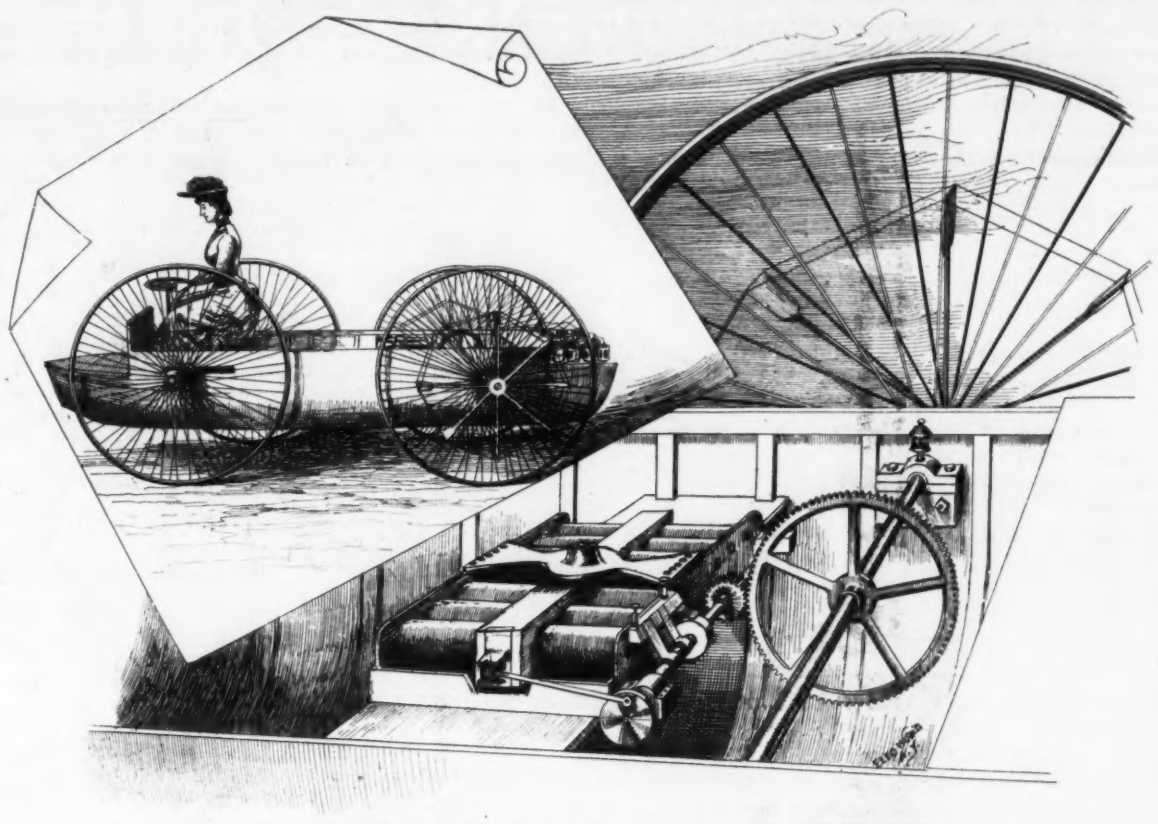
The combination consists of a C. & C. electric motor attached to a No. 4 Sturtevant exhaust blower. The pulley side of the blower was put upon a planer and a light cut taken off, so as to give a true surface for the attachment of the motor, the latter being of the standard type, modified slightly to suit the present case. The motor is fastened to the cast-iron frame of the blower, but magnetically insulated therefrom by brass pads 1¼ inches thick. The thinness of the iron casing of the fan also tends to prevent any appreciable leak of magnetism.

The motor end of the shaft is supported by a brass bracket from the top and bottom pole pieces. The end of this bracket is fitted with a sleeve of composition-bearing metal made in the simplest possible form, and so arranged that in case of wear it can be easily and quickly changed. The far end of the shaft is supported by a long babbitted bearing, both bearings being lubricated by automatic stop-feed oil cups. The insulation resistance of this motor is 10 megohms.

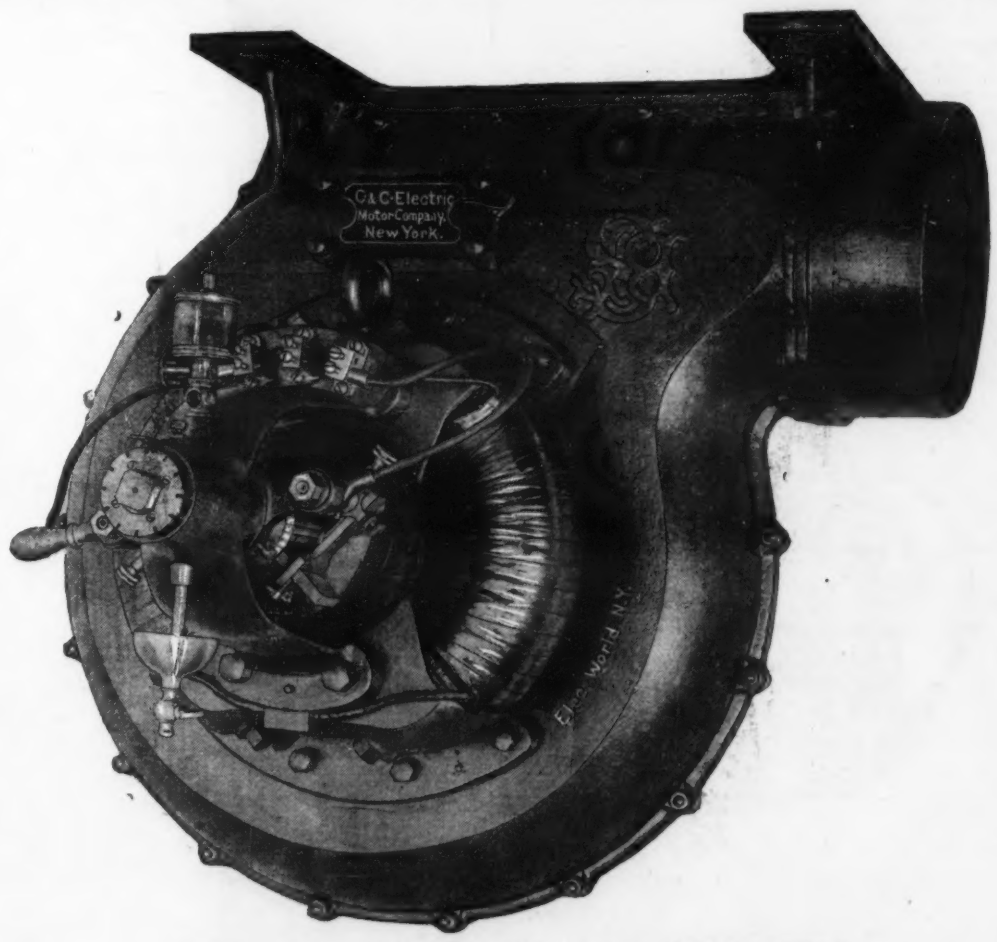
The combination is excellently adapted for blowers, for furnaces, etc., and two very large ones are now under construction for this purpose.

The Truax Electric Land and Water Vehicle.

Quite a novel piece of apparatus is now nearing completion at the works of the Freeman Electric Manufacturing Company, of this city. It consists of a boat mounted upon four wheels, and provided with an electrical equipment for its propulsion. The apparatus complete is shown in the accompanying engraving, and the motor part of it is also shown in detail. As will be seen, it consists of a reciprocating motor which connects with the axle upon which the wheels are mounted. The motor itself weighs 87 pounds and the batteries 64 pounds, consisting of 20 storage cells of novel construction. The vehicle, it is said, can be run at 10 miles an hour. Mrs. A. F. Truax, the designer of this apparatus, has had in mind not only a vehicle for land travel but one which also could be used on water. For this purpose the body is in the shape of a boat, and, as will be seen, the wheels attached to the motor are also provided with paddles. Thus, upon entering the water, the apparatus is transformed into a boat with paddle-wheels. The woodwork of the boat is remarkably light, weighing about 35 pounds. The wheels weigh 24 pounds each, and the boat itself, with a load of 1,300 pounds, draws but five inches of water. It is expected that this apparatus will soon be ready for actual running.



THE TRUAX ELECTRIC LAND AND WATER VEHICLE.



MOTOR AND BLOWER ON THE U. S. S. 'BALTIMORE."

Simple Deductions from the First Laws of Electromagnetic Induction.

BY J. M. B.

If there extend through a coil of wire, *C*, Fig, 1 (page 22), lines of magnetic force, even though at the moment we are exerting energy to keep the lines there, no difference of potential will be found to exist at the ends of the coil, nor will there be, as we know, until there occurs a change in the number of lines embraced by the coil. Let us say that we are, at the moment, exerting energy to keep the lines extended, and that we are to induce a difference of potential between the ends of the coil *C*. A simple way to consider it is, that unless we move the coil we cannot produce a change in the number of lines; and, hence, if we do not move the coil, or *do work*, we must not expect to create potential energy.

Now, exerting energy or performing work at the moment to keep the lines of force or the magnetic field in existence, means that we are keeping magnetized a soft iron bar; then, since the tendency of the iron is to demagnetize, we have here one of those cases where we are *doing work* to balance a force, similar to that shown in Fig. 2, in which continuous rotation (work) causes centrifugal force to keep a weight suspended against the force of gravity; and in Fig. 3, where the continuous rotation causes magnetic force to keep suspended a weight against both gravity and the tendency of the iron to demagnetize.

Let us imagine that there exists an atmosphere of a certain character, in a certain condition, brought to that from its normal condition by the expenditure of energy or work, and suppose that we could produce certain results with this medium by means of its friction against a certain substance; then, to obtain a result, *further work* is required, the increment of work being independent of the continuous expenditure of energy which might be required to keep our atmosphere in the abnormal condition. That is to say, that even were we to do an infinite amount of work on the medium, still we would obtain no results on our substance; but it is not to be understood that with this increased intensity of our medium a given amount of *further work* on our substance would not give increased results.

Now suppose that in Fig. 2 the action served to compress air in a vessel, the potential energy of which we wished to utilize in the production of mechanical movement. With an arrangement as shown in Fig. 4, the act of compressing the air in vessel *H* would give the paddle wheel *P* a slight movement, but when the continuation of the work on the air failed to compress it to a greater degree, but kept it at a certain compression, the movement of the paddle wheel would cease, after which it would not again move—although we are working just as hard on the air—until we discontinue the work, when the air will expand, causing the wheel to move once more.

Now, since in the case of the coil in the magnetic field, any work done on the coil necessarily produces a change in the number of lines of force inclosed or cut by said coil, resulting in the generation of a difference of potential, or, with a closed coil, a current, it follows, of course, that the laws governing the work required in the generation of current in a coil in a magnetic field by its own movement are such that, no matter how we produce the the change in the number of lines or intensity of the field,

we must perform the same amount of work. But there are two elements which enter into the case which must be considered.

Producing the change of lines inclosed by the movement of the coil, the E. M. F. induced would be as shown by Thompson :

$$E = \frac{N_1 - N_2}{t}.$$

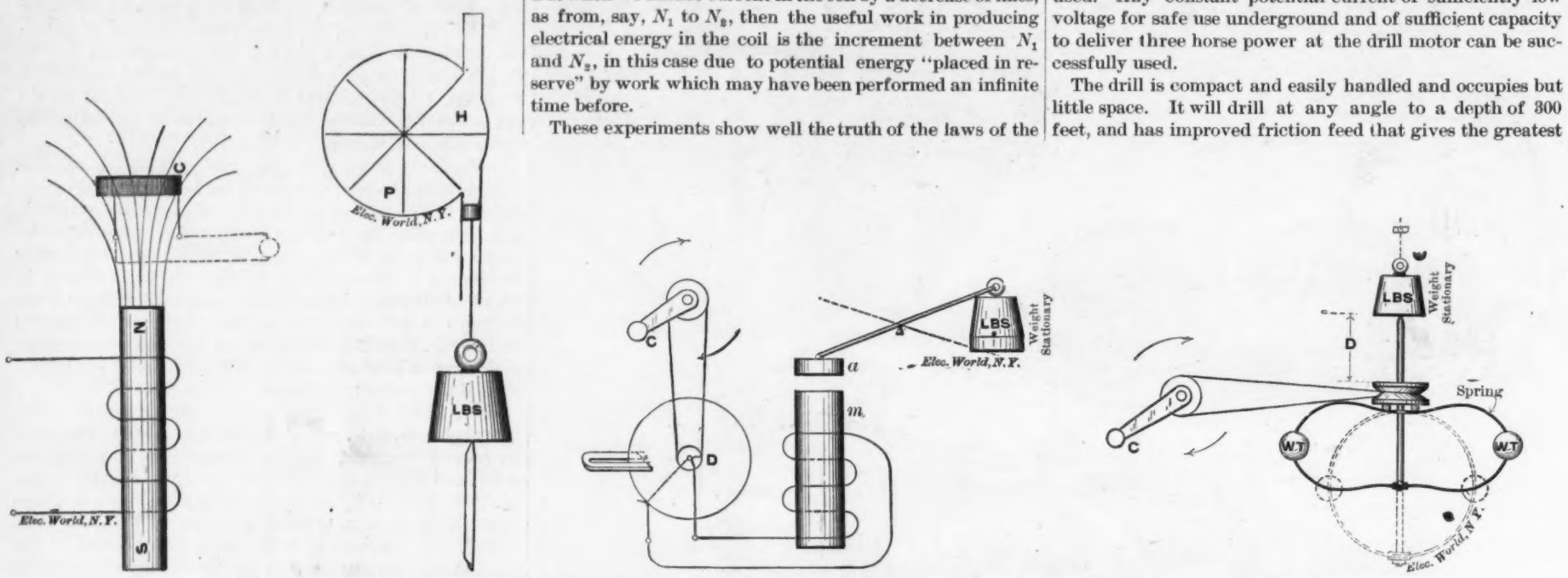
where N_1 and N_2 represent respectively the number of lines cut before and after the movement, and t the time ; here the work being dependent only on the weight of the coil ; and if the coil is closed :

$$C = \frac{\frac{N_1 - N_2}{t}}{r}; \text{ or } C = \frac{N_1 - N_2}{t\,r};$$

where r is the resistance of the coil circuit ; the work here being the same as before, plus the expenditure of energy required to overcome the opposition to movement caused by the mutual repulsion or attraction of the lines of the field and counter lines due to the current in the coil ; and it is only this last amount of energy expended that appears as electrical. If the movement of coil is such as to increase the number of lines inclosed by the coil, then of course will N_2 be greater than N , thus giving a negative value to C which, as shown by Silvanus Thompson, simply means that the induced current is relatively opposite to that current which generates the magnetic field in which the coil moves.

In producing the change of lines by varying the current exciting the inducing magnetic field, if we increase the number of lines we perform additional work, and the amount of this extra work should equal the output in electrical energy of the coil, not taking into consideration losses due to foreign conditions; imagining in this case the efficiency of the conversion of energy to be 100 per cent. But when we induce current in the coil by a decrease of lines, as from, say, N_1 to N_2, then the useful work in producing electrical energy in the coil is the increment between N_1 and N_2, in this case due to potential energy "placed in reserve" by work which may have been performed an infinite time before.

These experiments show well the truth of the laws of the conservation of energy, for as Lenz first pointed out, the induced currents are of that direction which tends to oppose the performance of the work that produces them.



FIGS. 1, 4, 3 AND 2.—SIMPLE DEDUCTIONS FROM THE FIRST LAWS OF ELECTRO-MAGNETIC INDUCTION.

The Sullivan Diamond Drill Operated by Electricity.

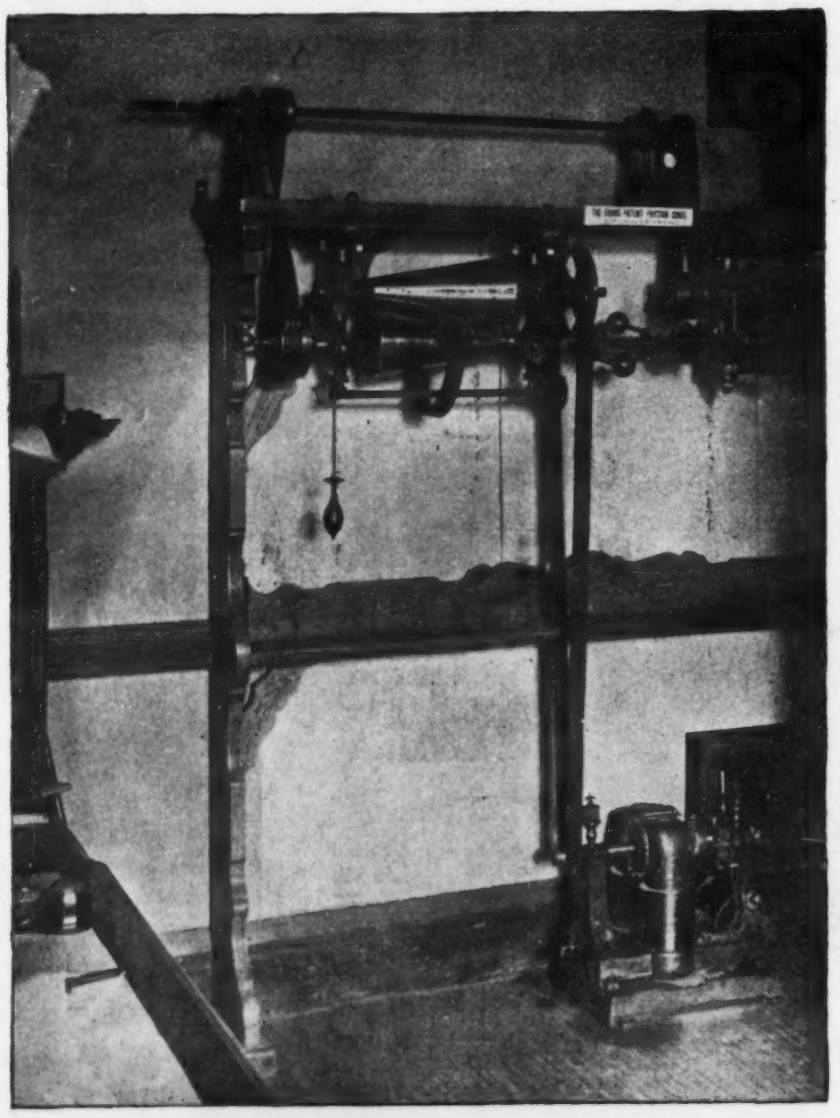
The electrical Diamond drill, says the *Engineering and Mining Journal*, is another illustration of the growing demand for mining machinery operated by electricity, and of the steps our mechanical engineers and manufacturers are taking to meet this demand. The adaptation of the Diamond drill to be operated by electricity cannot fail to widen largely the already rapidly growing field for these machines.

One of the difficulties in the way of the use of the Diamond drills underground and in rough, mountainous localities has been to get power to the machine. Where a mine is supplied with compressed air this difficulty does not exist. But many mining companies have no compressor plant; and the use of steam underground is always most objectionable, and frequently, when persisted in, a source of great expense from the damage caused by the action of the exhaust steam on the timbers and rock.

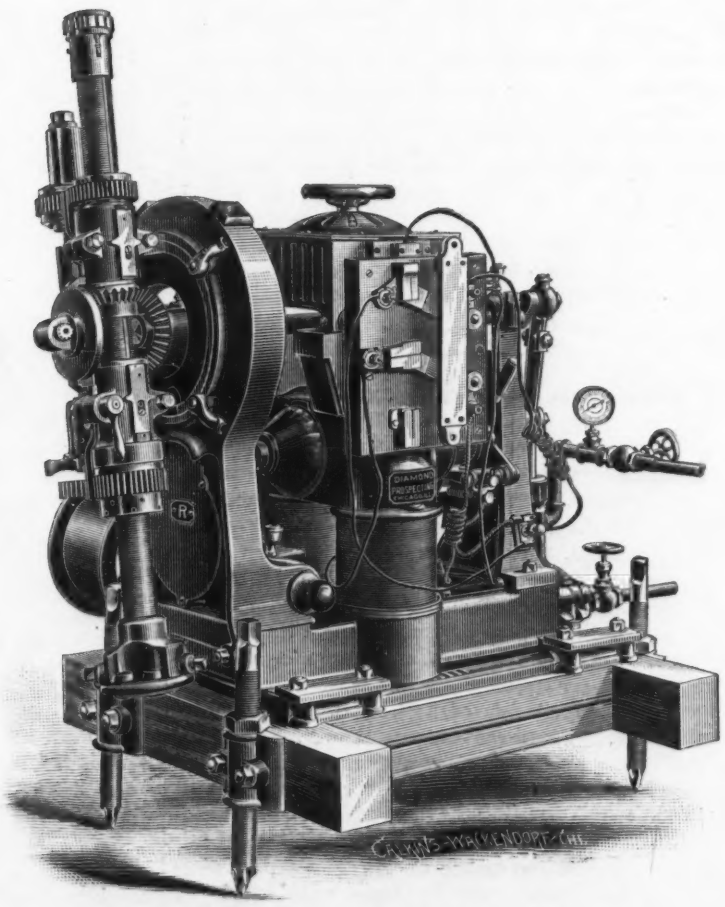
The electric Diamond drill possesses the great advantage that the power to operate it can be carried easily, rapidly and inexpensively to the points where the drill is to be used. Any constant potential current of sufficiently low voltage for safe use underground and of sufficient capacity to deliver three horse power at the drill motor can be successfully used.

The drill is compact and easily handled and occupies but little space. It will drill at any angle to a depth of 300 feet, and has improved friction feed that gives the greatest possible rate of progress with slight wear on the bit. The pump is a part of the machine, and is operated by the same motor, a Thomson-Houston, of special design, wound for various potentials, and running at 1,200 revolutions.

These machines are manufactured by the Diamond Prospecting Company, Chicago, Ill.



MOTOR DRIVING FRICTION CONE, EXHIBITION PLANT.



SULLIVAN ELECTRIC MINING DRILL.

Thomson-Houston Motor Operating Friction Cone Machinery.

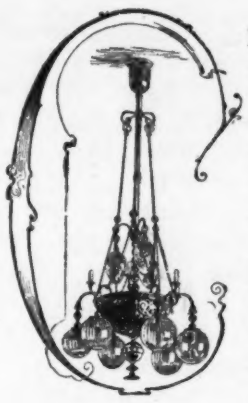
The motor installation shown in the accompanying cut emphasizes one of the important advantages of the electric motor—that is, the possibility to use it in an exposed position in an office, where the use of steam power would be entirely out of the question. The cut is made from a photograph of the office of the Evans Friction Cone Company, Boston. The motor is used for operating the exhibition plant of the friction cone machinery manufactured by the company.

The ease with which it can be started and stopped, the small space occupied, its cleanliness and noiselessness render it at once the best form of power which could be used for the purpose. The installation was made by the Thomson-Houston Motor Company.

A NEW YEAR CALL

AT

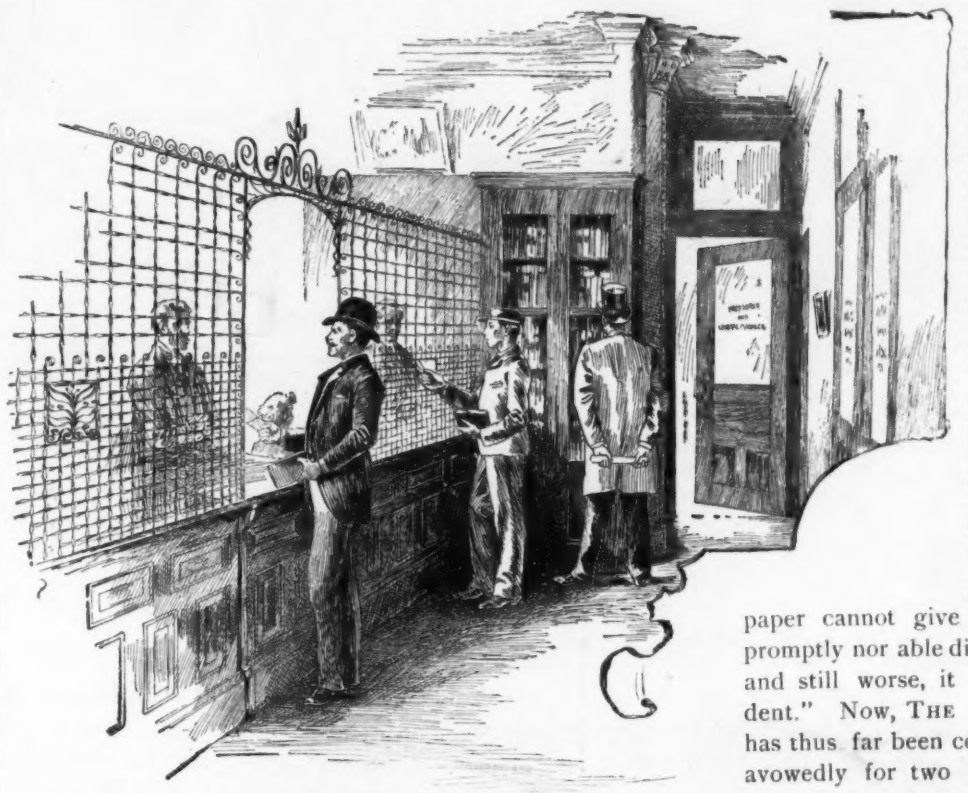
"The Electrical World" Offices.



CLOSE upon three years ago, at the time of the removal of THE ELECTRICAL WORLD from its old offices in Murray street to the Potter Building, the opportunity was seized to issue a small illustrated pamphlet containing views of the new quarters and giving a brief sketch of the history of the paper. We believe that the pamphlet then put forth succeeded in establishing even closer relations of friendship and esteem between THE ELECTRICAL WORLD and its readers than had before existed. "A good, healthy, long-lived newspaper is not an easy blessing, but one that comes to us through the fire," said the Rev. T. De Witt Talmage once, in his epigramatic way; and the readers of the journal thought none the worse of it after learning how it had stood the strain and stress of poverty and upbuilding before it had become an element of importance and a power for good in the development of electrical science and application in America.

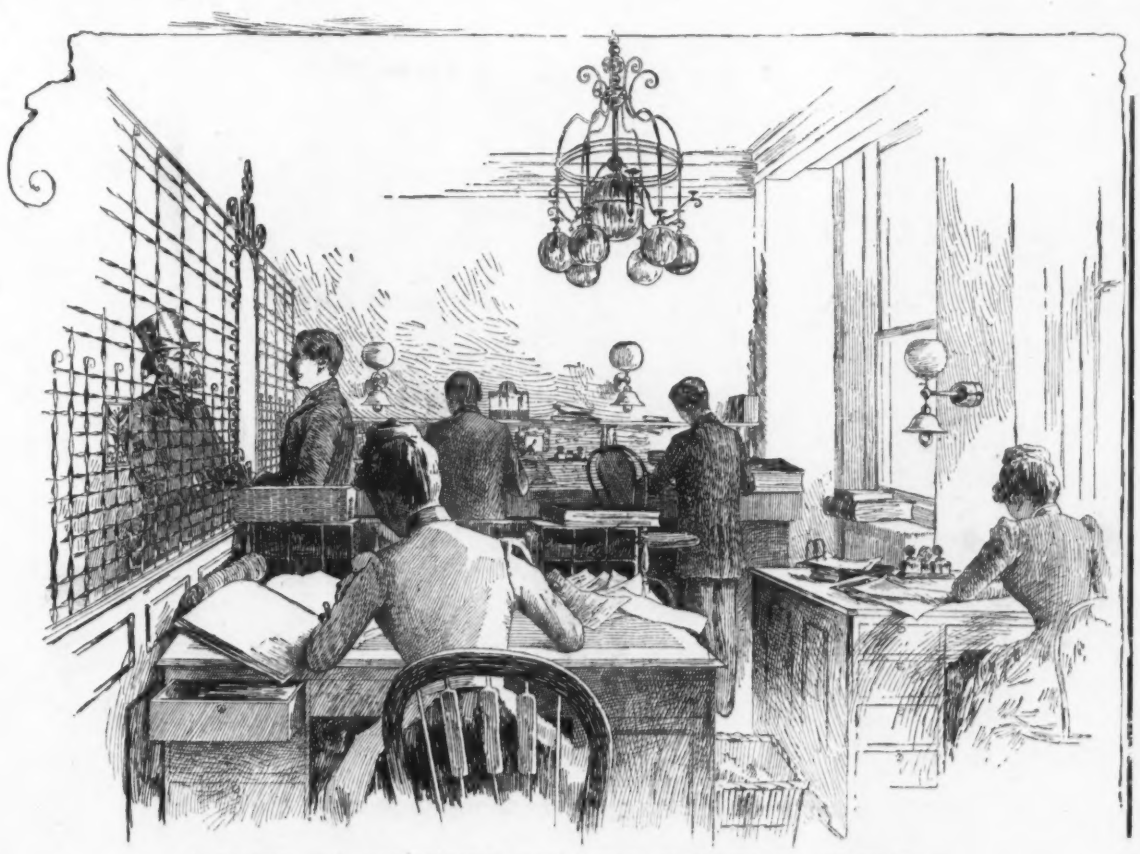
After yet another season of growth and prosperity, THE ELECTRICAL WORLD has once again required more elbow-room for its rapidly expanding business, and it is felt that the recent occupancy of larger quarters in the magnificent new *Times* building furnishes an appropriate occasion to review the past and speak of plans for the future. The series of illustrations presented in this article, with such remarks as may be needed by way of elucidation, will serve to show how extensive are the facilities already demanded, and how ample must be the resources of an enterprising, first-class scientific journal that is determined to cover the field. So far are we from regarding as impertinent the interest with which the paper is watched, that we are encouraged by the manifestation of intelligent and friendly curiosity, not only to better performance, but to give our readers some idea of the manner in which the work of such a periodical is actually done.

While we would be slow in asserting that "To man, to govern, to propel a newspaper until it shall be a fixed institution and a national fact demands more qualities than any business on earth," we certainly shall have no hesitancy or difficulty in showing that a paper like THE ELECTRICAL WORLD must reach a high degree of organization before it can successfully accomplish its purpose.



BUSINESS OFFICE OF "THE ELECTRICAL WORLD."

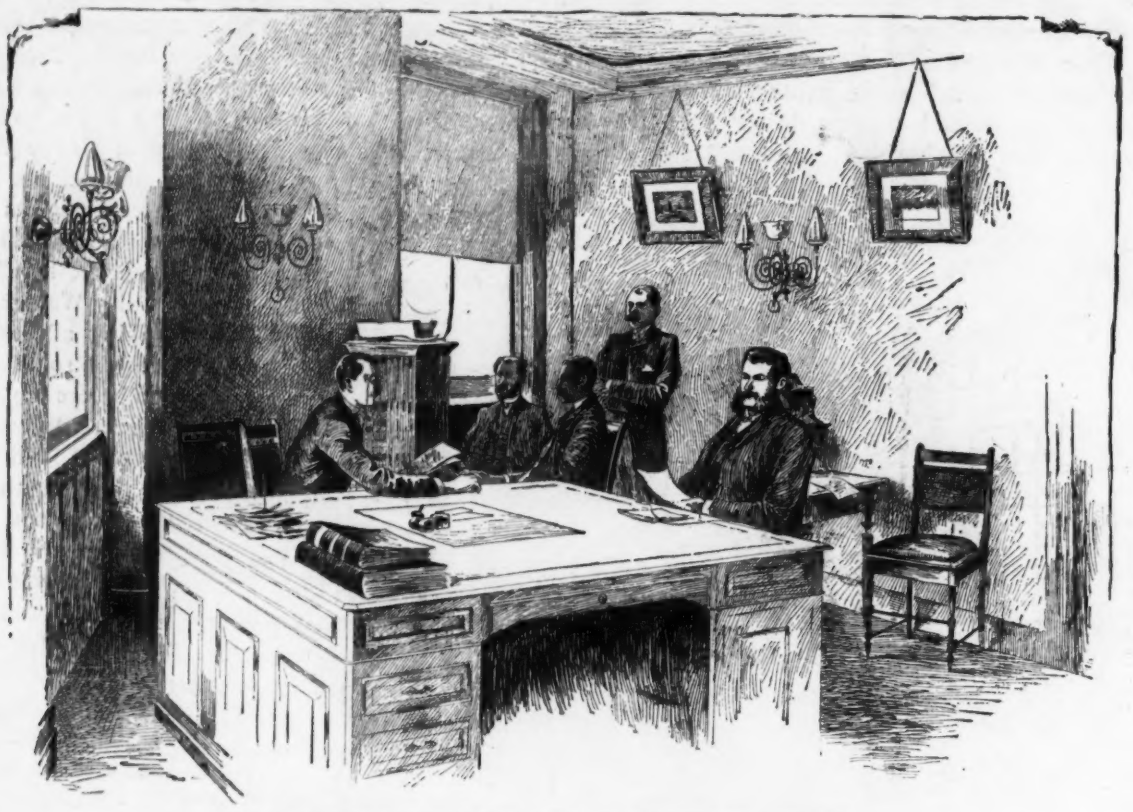
Heinrich Heine remarks somewhere that nowadays men fight for ideas, and that newspapers are their fortresses in the intellectual campaign. This is true, yet it is not less true that the world has but a small place for the journal that exists simply to ventilate an idea. Dr. Robert Colyer perceived the point when he said: "The newspaper is the grandest force after the pulpit. Better things are in store for the press. It is making money, and when a newspaper becomes rich it can afford to be independent." This is an extreme statement of the sound principle that a newspaper has its commercial side, but it serves to define at once the mission and the best basis of support that a journal can have in realizing its lofty ideals. The truth was closer hit by Charles Dudley Warner, in a striking address delivered some years ago before the Social Science Association, when he laid down the doctrine that "if the excellence of a newspaper is not always measured by its profitableness, it is generally true that i it does not pay its owner it is valueless to the public. The impecunious newspaper cannot give its readers the news promptly nor able discussion of the news; and still worse, it cannot be independent." Now, THE ELECTRICAL WORLD has thus far been conducted frankly and avowedly for two objects. In the first place it has devoted itself to the promotion of electrical interests. In the second place, it has endeavored to become as profitable a paper as the conditions would allow. Broadly and representatively electrical from the very hour of its birth, it has never been entangled or restricted by improper allegiances nor been so embarrassed by financial claims and pledges that at any stage of electrical development it was not able and willing to help forward the newer evolutions of the art. Telegraphy never had a stancher advocate; yet telephony also found its exponent in THE ELECTRICAL WORLD. The merits of the incandescent lamp have not lacked its warm appreciation, but have been enlarged on, in season and out; while the arc lamp has always had enthusiastic support for its claims. It was in the pages of this journal that a department was first assigned to electric power; and the storage battery in turn has to-day no heartier friend. Its reputation for strict impartiality and fairness in all questions concerning competing inventions, systems or companies has become world-wide. The columns of the paper have been wide open at all times for the discussion of the relative claims of the continuous and the alternating current, and should some better method than either of obtaining and distributing electricity present itself, as it may, THE ELECTRICAL WORLD will not be hindered by any prejudice, bias or allegiance from printing all that can possibly be said in behalf of the new candidate for popular favor.



'I WANT TO SUBSCRIBE FOR 'THE ELECTRICAL WORLD.'"

The offices of THE ELECTRICAL WORLD are in the stately new *Times* Building, facing on Park row, Nassau street, Spruce street and City Hall square. The building is one of the sights of New York, its loftiness, solidity and beauty rendering it remarkably conspicuous and attractive. It is built in a pure Romanesque style, of light granite, relieved by a bright gray limestone, and its thirteen stories attain an altitude of nearly 200 feet. THE ELECTRICAL WORLD offices occupy a large portion of the ninth floor, including rooms 167 to 177. This suite consists of the following departments: Business office,

president's office, correspondence room, business manager's office, editorial rooms, library and reading room, advertising department, patent department, patent library and drafting room. All these rooms are divided from each other by massive old oak and glass partitions and connected by broad corridors. They are brilliantly lighted from the United States plant, in the basement, of two dynamos driven by two Straight Line engines. Some of the lamps are carried by handsome fixtures made by the Archer & Pancoast Manufacturing Company, while the chandeliers and brackets supporting the others were specially made for these rooms from original designs by the Bergmann Electric and Gas Fixture Company.



A CONSULTATION IN THE PRESIDENT'S OFFICE.

The illustrations scattered through these pages give an excellent idea of the offices. On entering from the outer hall, one is courteously received in a large, light and airy room known as the Business Office. Here the principal bookkeeping is done; here the letter mail is received and dispatched; here inquiries are made by visitors. The room is elegantly fitted up in brass and oak, and divided by a partition, within which are busy clerks and accountants. In case the visitor desires to learn about an article that has appeared in a number of The Electrical World, the matter is immediately hunted up, and probably information will be given him as to other data available on the subject. If he is in search of the latest electrical books, his attention is directed to the collection in the bookcase against the wall, which contains every work in English in the market relating to electrical or kindred subjects, foreign as well as American; and these he is at liberty to dip into until he finds what he wants. Near the bookcase hangs a bulletin board announcing the latest issues from the presses of Europe and America relating to electrical subjects, and giving also notice of meetings of electrical societies, etc., about to take place. As to the book-keeping, it will suffice to mention that there are some three to four hundred advertising accounts to keep track of, with all the various details attendant upon the appearance of the advertisements. A large amount of work is also entailed by the subscription records, mail orders for books and the endless ramifications of heavy publishing.

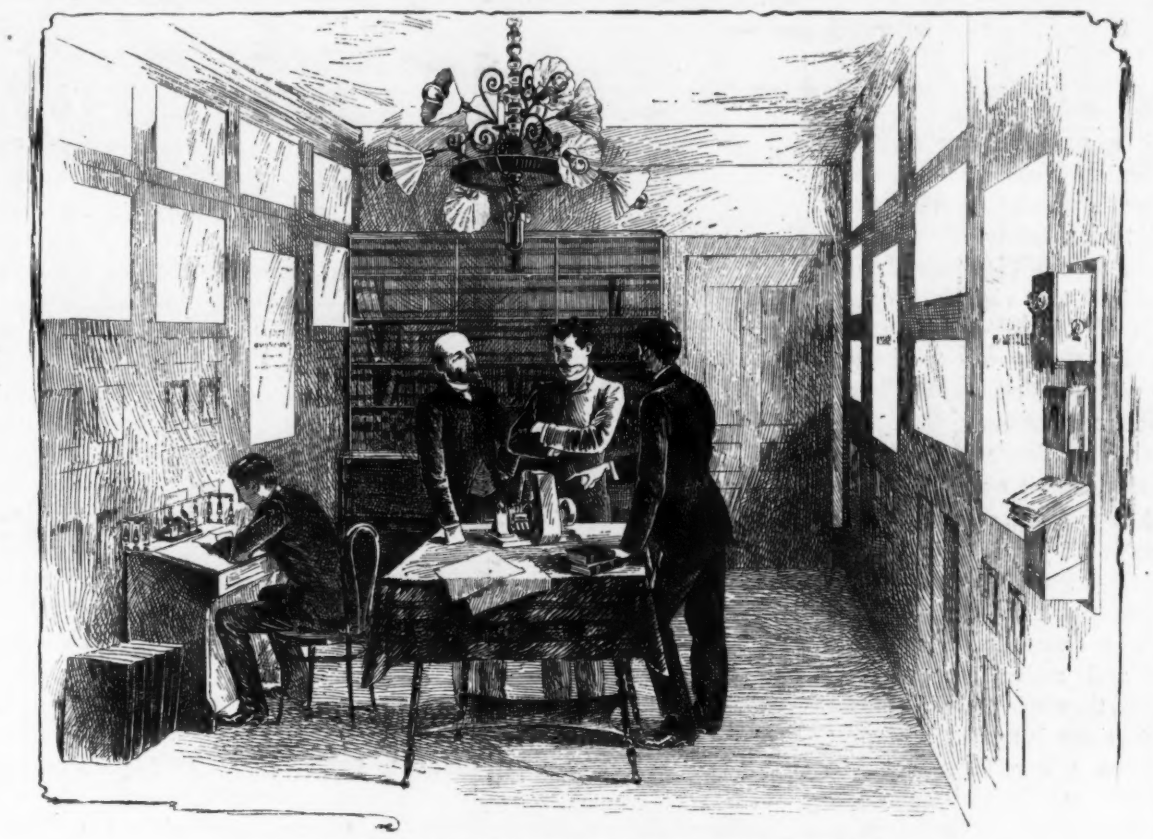
The disposal of the mail matter received has been referred to. This is not an easy task. Of course there is no difficulty in distributing the personal correspondence for any of the officers and employés of the company, but there remains a vast bulk of miscellaneous letters that require thought and careful treatment. These letters come from every quarter of the globe, and their contents are often not less puzzling than amusing. The idea is now pretty well instilled everywhere that in the practical applications of electricity America takes the lead; and hence it is natural that The Electrical World should receive from far-off lands inquiries in regard to every possible kind of invention. The mail clerk spends a well-occupied morning with such correspondence. This letter is from a reader in the West, who wants to know whether a certain device for making butter by electricity is patentable. The next is an angry complaint that the paper last week was delivered a mail late, or that since the subscriber changed his address—of which fact this is the first notification—he has not been receiving his copy at all. The next letter contains some newspaper clippings from a friend up East. This is an order for books, with a remittance that leaves the company a wide discretion in making up the invoice. Here is a letter from the West Indies asking if there is such a thing as an electric fly-trap, and naming a New York commission house through which to export it. The Governor of the Island wants the trap, but he will have to get along without it. Here is a note from a Southern lumber-mill owner, stating that he proposes to put an incandescent plant in his mill, and would like mention of the fact. Another letter from the New South inquires as to the best system of arc lighting, while a third unfolds a plan for running an electric road by water power, and asks whether any wire has yet been invented that will carry the current without loss. This letter with a slight cockroachy smell about it is from Central India, and incloses an order for some special incandescent lamps and other devices with which the writer desires to alleviate his exile. Here is an inquiry as to an article which is supposed to have been published in the paper five years ago; and the next is on patent business. So it goes, down through the whole pile, and when at last the mail has all been sorted, distributed, checked and annotated, it may be taken for granted that a very pretty day's work has been cut out for everybody.

We could, if we wished, follow one of these letters on its course through the office, but the same result may perhaps be attained with less travel over and over the same ground, by performing the inspection leisurely, and as does a man who, calling to see his friend newly installed in a house, makes the tour from the mansard roof down to the cellar and out to the barn. The caller at the office of The Electrical World finds himself, as we have said, in the Business Office. To the left runs a corridor that takes him to the President's Room, from which he will get a wonderful view all over the city, across the Hudson to the low, misty Jersey shore and the Orange Mountains beyond; and then, turning up, the line of the Third Avenue Elevated Road as far as the borders of Westchester County and the windings through which the East River broadens out and merges into the silver Sound. Here the visitor is apt to linger, whether business requires it or not, for when his eyes wearies of the far view, he looks down with renewed interest on the bustling scene below. Immediately at his feet is Printing House Square, with its grimy but sedate statue of Benjamin Franklin and its inquisitive crowds surging around the placards of the newspaper offices. Across the way is the City Hall, encircled by trees and walks, and, nearer still, is the General Post Office: Just across the park, a short block from the offices, is Broadway, with its stimulating whirl and pressure of traffic, yet whose roar and din are agreeably tempered and refined by the distance. And then, as our gaze once more involuntarily goes afield, we see the big ocean "greyhound" plowing her way slowly up the Hudson to the dock, or lunging rapidly down the bay, eager for the keen strife that awaits beyond the sand bars of the Hook.

It is to be remembered that these are the headquarters of a large publishing house. There are some concerns that simply publish a paper; others that restrict themselves to the printing of books, and others again that deal merely in the publications placed in their hands for sale. The W. J. Johnston Company, Limited, has, partly from necessity, partly from choice, combined the three functions. With regard to The Electrical World itself, something

A GLIMPSE OF THE CORRESPONDENCE DEPARTMENT.

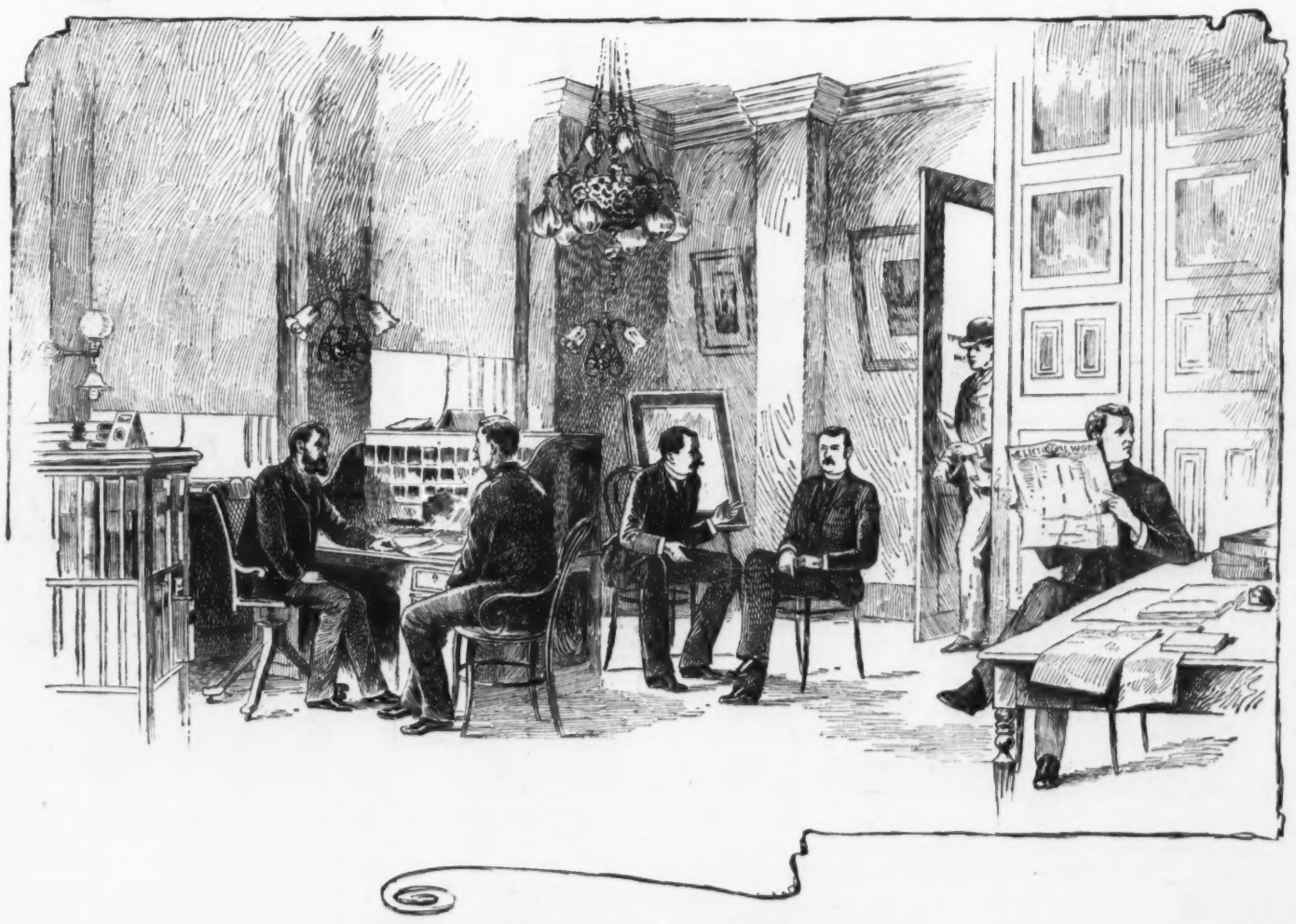
will be said further on, but we may here note the fact that in addition to its large electrical bookselling business, the company has issued a number of notable works. Among these may be mentioned such books as Lockwood's "Practical Information for Telephonists"; Lieutenant Swift's "Practical Telegrapher" (now out of print); Maver & Davis' "The Quadruplex"; "The Report of the Electrical Conference of 1884"; W. J. Johnston's "Lightning Flashes"; Martin & Wetzler's "Electric Motor and its Applications"; Carl Hering's "Dynamo Electric Machines"; Atkinson's "Static Electricity," and Professor Houston's "Dictionary of Electrical Words, Terms and Phrases." Few persons have any idea of the amount of work and detail involved, for example, in such a work as the last, even after the author has put his final painstaking corrections and emendations on the manuscript or proofs. The "Dictionary," which is practically an encyclopedia in brief, is a substantial volume of 655 pages, containing about 2,500 words, terms or phrases. A pioneer work of this nature is obviously beset by many serious difficulties, but evidence of the extent to which they were overcome is afforded by the hearty welcome given the "Dictionary" everywhere, by laymen as well as by experts, and by the professional press as well as by the big dailies that mold public opinion. It might be added in passing that there is no work relating to electricity that is not either published or at least for sale by The W. J. Johnston Company, Limited, and that besides its retail business the company does a large and growing jobbing trade in supplying electrical books in quantities at wholesale to booksellers, electrical supply houses and others.



DISCUSSING ITS GOOD POINTS IN THE LIBRARY.

Adjoining the President's Room is the Correspondence Department. This has its own head, and has a complete staff and equipment for carrying on its important and responsible work, of which some idea has already been given in the description of the incoming mail. But it need not be supposed that this department depends upon exterior influences for its stimulus. As an agency for developing the ideas that are suggested within the office by the executive, it creates its own work to a very large extent; and no man or enterprise is long in the field before he or it is invited to become better known. An obscure inventor concerning whom a stray item finds it way into the remote local weekly is suddenly set in a flutter by the offer of the opportunity of presenting himself and his ideas before the electrical public; and the new company, launched timidly by half a dozen poor men, is delighted at the shrewd advice as to the best means of working up a demand for its novelties. Possibly there may be no response to the well-meant, kindly salutation, but there are instances not a few wherein this cordial reception has been the beginning of a prosperous career. It is amazing, also, to see here what a vast amount of work can be accomplished in a day with the aid of a type-writing machine and the "rapid transit" pencil of the stenographer. Coming back to the business offices, we now pass to the right and find ourselves in the office of the general manager and treasurer, an important personage who guards the finances and keeps the wheels of the machine in steady, smooth and swift revolution. The first thing the visitor has to do is to place his autograph in the Register, where any number of callers and "globe trotters" have already inscribed themselves. Then he will look out at the gray Brooklyn Bridge and the East River ferry boats, plying to and fro like ceaseless shuttles; or he will be surprised to find himself on the level of the big *Tribune* clock, which shakes a lean, warning finger at him to remind him of the flight of time and of its value in so busy a corner. The duties performed in this office are varied and multitudinous. The work of instructing the engraver as to the details on a number of blocks to be cut is interrupted by an inquiry from an advertiser as to when he can get the upper corner of the front cover; and he makes way for a subscriber from Chicapolis who wants introductions to all the electric light stations in town. This agreeable task disposed of, the less pleasant one has to be gone through of dismissing politely a plausible gentlemen who wishes to pay for a page advertisement and "a good puff, you know," with $100 cash and $1,000 in stock of the Perpetual Battery Lighting Company. Then there are estimates to be gone over for the new book publication in hand, or preparations to be made for printing the next "Banner Number;" and meanwhile, flake by flake, an avalanche of correspondence is accumulating and threatening to sweep away every spare moment of the whole week. But as evening sets in, and the mellow rays of the incandescent lamps fall softly, we see that the pile has, after all, been thinned down, and the way cleared for the toil of the morrow.

As we quit this room, we note on the walls a number of interesting portraits and views of buildings, etc. Just outside the door is a neat little annunciator serving for all the departments, with a boy in attendance to convey messages, letters, papers, etc. A door that is carefully kept closed, and would be kept locked if some of those interested were to carry out their sterner resolutions, leads us into the library, off which open the editorial rooms. Here is found, handy for reference, a complete set of volumes of THE ELECTRICAL WORLD and all the old files of its



FIVE MINUTES WITH THE BUSINESS MANAGER.

predecessor, *The Operator;* and it is cheering to see how the slim youth of earlier years has rounded out into this massive generosity of proportion, each year showing a fatter volume than the last. Here, too, are piles of all the electrical papers of the world, with many scientific and technical periodicals likely to contain matter of interest to electricians. These papers come in from England, France, Germany, Spain, Italy, Austria, Russia, Belgium, India, Australia, Japan, Central America and South America, and are printed in languages enough to start a new Tower of Babel. Their presence is in itself an indication of the wide-

ELECTROLIER IN LIBRARY.

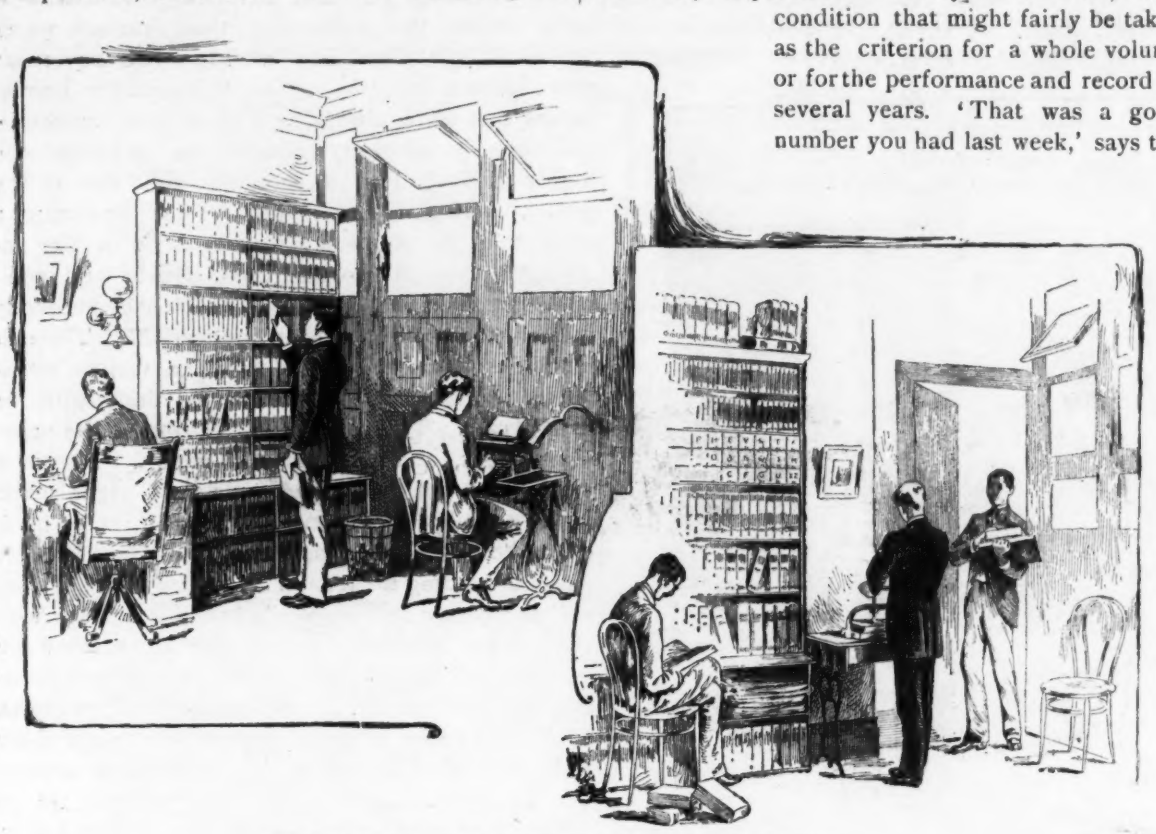
spread interest in electricity, for electrical journalism is of modern growth, and it would have been difficult a few years ago to make even a poor showing of this kind. In the centre of the room, under the graceful electrolier, stands a stout table upon which now and then the enthusiastic inventor will mount his new dynamo or motor the better to illustrate its good points by practical demonstration. In the library also is the telephone. The ordinary instrument has lately been supplemented by the long-distance service, so that the office can at any time hold communication with its regular correspondents in Boston and Philadelphia, or promptly verify a report or obtain information or details.

The "editorial chair" is very much like any other piece of furniture of its class, and the "editorial sanctum" is apt to be just a room and nothing more. The interest belonging to an editorial department depends very much on its product, and certainly not upon any special or peculiar charm surrounding the place in and of itself. Thus it would be proper to refer to the columns of The Electrical World in order to form an accurate estimate of its editorial department; and since it is one of the limiting conditions of humanity that a man shall introduce his personal equation into whatever he says and does, it may amuse the curious-minded to determine from the contents of the paper the quality and individuality of the editorial staff. Be that as it may, the visitor receives a cordial welcome here as elsewhere in the office, the more so if he can briefly offer a suggestion or thought that will help elucidate the electrical questions of the day, or will foreshadow the events to come. He will soon find that the work done here has more than one side to it. There is its technical side, and it need hardly be said that if there is one thing a technical journal guards and cherishes it is its reputation for accuracy and thoroughness. In such a tremendously progressive and active art as electricity, the strain to keep abreast of the times is unusually severe; yet the editor must not fall behind a single step or a single minute. If he does, some inquirer, like an avenging fate, will surely drop in upon him and ask for the latest information on the very topic whose mastery he had allotted to the next leisure hour. Then there is the current, historical side, or the field in which the wild dream of the visionary becomes the experiment of the engineer, the pet of the promoter, the play of the speculator, and, in the long run, the steadfast hope of the conservative investor. The record of all these contemporaneous movements must be kept up, and this in itself involves no little care and vigilance. Then there is the commercial side of editorial work. It is evidently to the interest of an electrical journal to encourage new enterprises, yet it must be watchful lest it be trapped into saying a good word for some mere stock-jobbing scheme, whose only aim is to fleece the unwary. Unless close discrimination is constantly exercised, the praise of the journal will go for nothing, and its easy good nature may render it an accomplice in evil. Another part of editorial work is one that gives little immediate public sign, and that is the filing away of data for future reference. Sooner or later use will be found for everything, and hence every catalogue, pamphlet, table, clipping, note, or document goes into its pigeon hole, awaiting the inevitable day of its resurrection, when it will be the very thing to meet some particular case. Besides all this, the editors necessarily follow critically the issues of all foreign electrical journals, and pounce at once on any new idea or development. Then there are countless inquiries from correspondents, some reasonable, others exacting, but all resting confidently upon the amiability of the unknown editor they address. And then, when all the matter has been prepared and the illustrations have been secured, and the last item of news has been "covered," the editor has to devote himself to the lesser but vital questions of mechanical perform-

MAPPING OUT AN EFFECTIVE "AD."

IN THE QUIET OF THE EDITORIAL 'SANCTUM."

ance involved in the "make up" of the paper. This article, he says to himself, will chime in very well with that; but if this goes in, the paper will be lop-sided, being either too much one way or too much the other, and hence, while the telegraphic reader may be delighted, the telephonic reader will feel neglected and the electric light superintendent will be disgruntled. Moreover, it is a matter of pride to be typographically "clean." Not only do readers expect this, but with some men it is the sin against the Holy Ghost to get one of their initials wrong. At last, the issue is through the press, and then the work is begun anew and gone over again. Fifty-two times a year the paper comes out, and the editor knows that though each number counts as another test of his endurance and ceaseless anxiety, it is not his place to proffer excuses for shortcomings, but to set his resolves all the time on a higher standard of production and achievement.



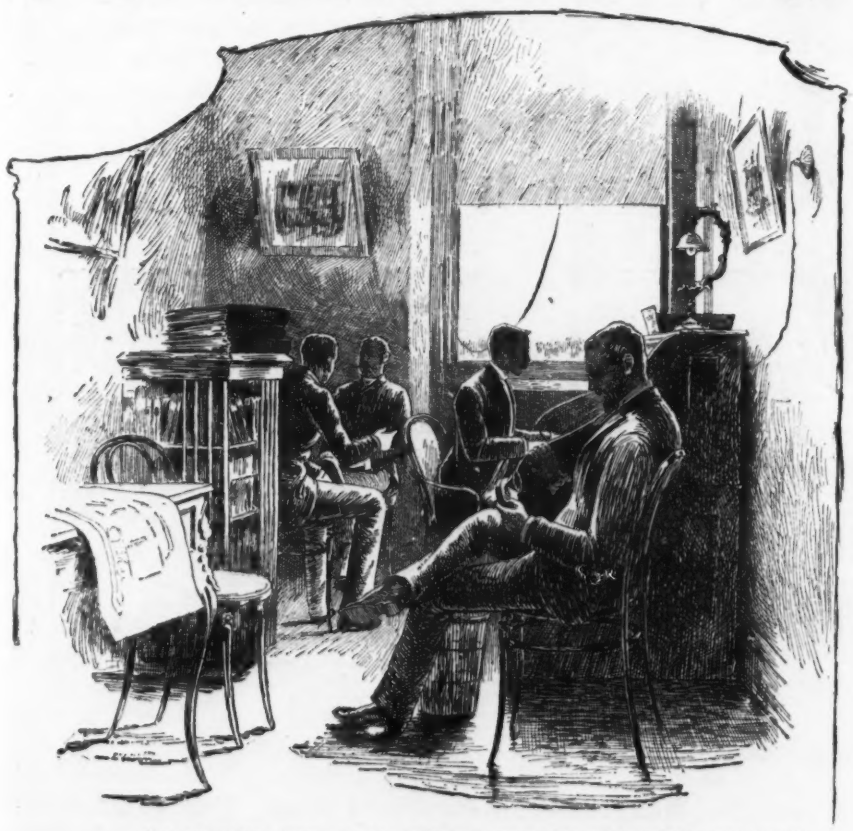
CONSULTING THE PATENT AGENCY RECORDS.

In a little pamphlet issued about a year ago from THE ELECTRICAL WORLD, entitled "The Making of a Paper," appear the following remarks, which are pertinent in this connection: "Few things are as difficult to maintain as a high standard of excellence in a journal that has won place and reputation, and from which nothing short of the best is expected. Yet it may be doubted whether the lofty ideal aimed at and reached is always seen and appreciated as it should be by those who read the periodical regularly. The very punctuality with which the paper is delivered to its readers is in itself a means of dulling the perception of merit, and the persistency with which the standard is kept up, issue after issue, tends to prevent the outburst of applause that would come as the recognition of occasional or sensational efforts on a lower plane.

"Besides this the variety of tests applied to a good paper by its critics will, in themselves, while an admission of its value, do it an injustice, because it is manifestly impossible to satisfy, each week, every condition that might fairly be taken as the criterion for a whole volume or for the performance and record of several years. 'That was a good number you had last week,' says the subscriber who happens to meet the editor or publisher; and he proceeds to speak of a certain article that appealed to him specially and had given him highly useful and timely information. Only two weeks before, however, he may have gone through the paper as usual, and simply said to himself, 'Pretty fair this time,' or 'Rather dry', when, in point of fact, a dozen other readers had written in, saying that as long as they could get such matter as that they did not care how much they paid for it. Now, it is more than likely that throughout the same editorial policy had been adhered to, the same care exercised in securing original contributions or in selecting articles, and the same effort exerted to make the paper the fresh, strong, readable, indispensable and representative journal that all who are familiar with it know it to be.

"It might not be amiss to consider what are the relations between its readers and such a journal as THE ELECTRICAL WORLD, for example. They would be found, on examination, to involve many principles and functions that had not been suspected, and to work out in their broadest application some of the ideas that most directly govern modern society. One of these principles will be enough, however, to arouse thought. We might deal with the paper and the responsibilities and opportunities it encounters in the field to which it devotes its energies. There are also its relations to the reader and to the advertiser, distinct yet independent. There are the duties of the paper as representative of a great profession and industry. Though a special advocate in one sense, the very publicity of its utterances leads it to the forcible and the true in its statements and arguments, and amid the strife of conflicting interests it becomes not merely a skillful pleader, but an honest witness, an impartial judge and an open court where every cause may be brought for hearing. Its broadness of view is against narrowness of sentiment, and he extent of its field compels it to give a liberal education in the arts and sciences to all whom it reaches."

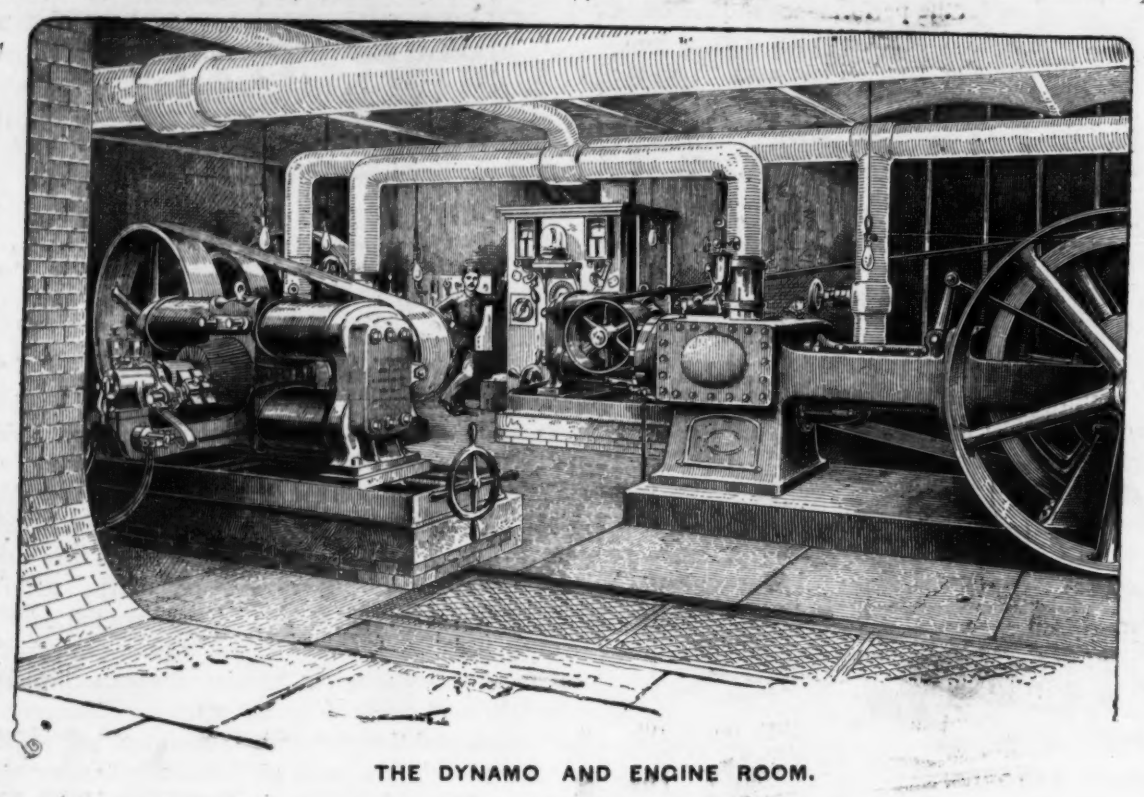
A word or two should be said here with regard to the contributors to THE ELECTRICAL WORLD. The list includes the following well-known names. Prof. W. A. Anthony, Prof. A. E. Dolbear, Prof. E. J. Houston, Prof. John Milne, Prof. E. L. Nichols, Prof. E. P. Roberts, Prof. Elihu Thomson, Prof. J. B. Webb, Dr. Louis Duncan, Dr. G. A. Liebig, Dr. Otto A. Moses, Dr. Donato Tommasi, Dr. Vander Weyde, Dr. Schuyler S. Wheeler, Lieut. B. A. Fiske,



"I THINK WE CAN GET A BROAD PATENT ON IT."

IN THE DRAFTING DEPARTMENT.

U. S. N.; Lieut. J. B. Murdock, U. S. N.; Lieut. F. J. Patten, U. S. A.; Engineer W. D. Weaver, U. S. N.; E. G. Acheson, John Beattie, Jr., E. Berliner, A. E. Braddell, C. S. Bradley, W. F. Collins, C. G. Curtis, G. Cutter, P. B. Delany, R. S. Dobbie, C. L. Edgar, S. H. Emmens, P. H. Engle, I. H. Farnham, S. D. Field, T. F. Gaynor, H. D. Hall, C. L. Healy, Carl Hering, R. M. Hunter, W E. Irish, F. W. Jones, A. E. Kennelly, E. R. Knowles, Thos. D. Lockwood, C. O. Mailloux, G. W. Mansfield, Wm. Maver, Jr., J. M. Moffatt, A. Partz, A. Pfannkuche, G. B. Prescott, Jr., I. L. Roberts, E. E.



THE DYNAMO AND ENGINE ROOM.

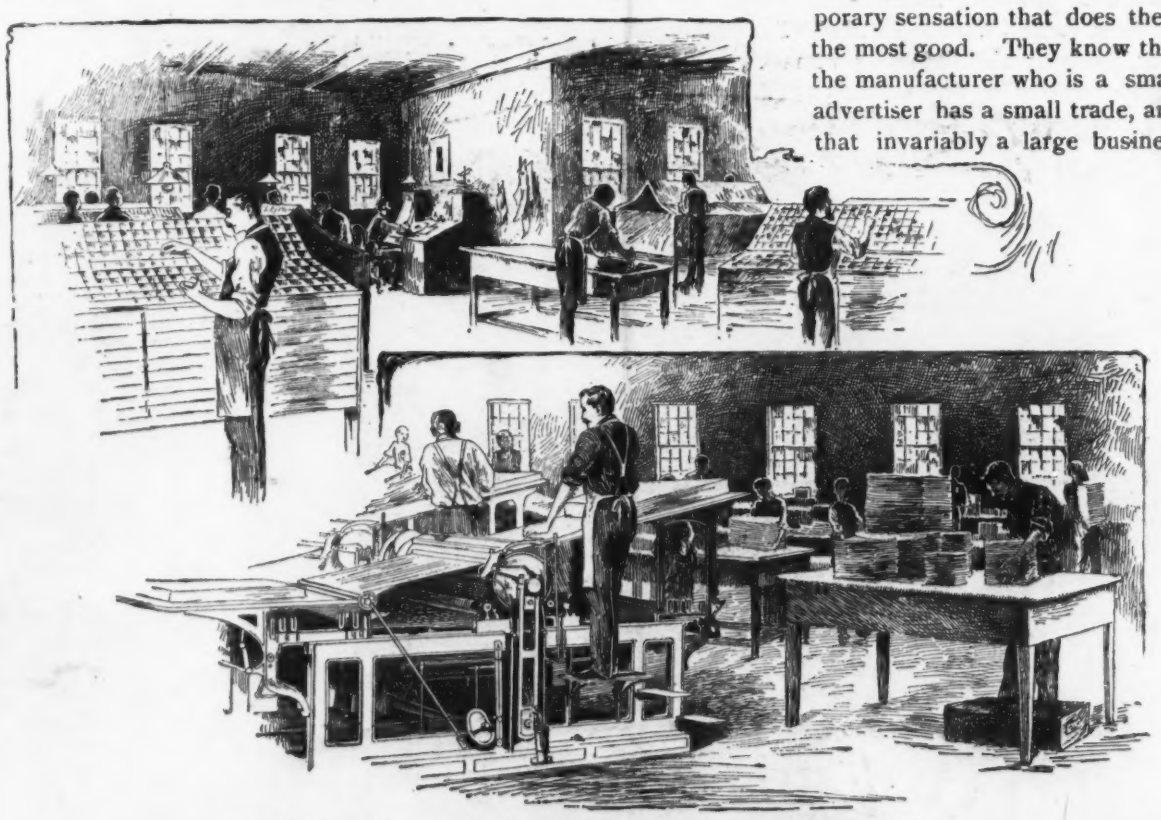
Ries, W. M. Schlesinger, F. J. Sprague, L. W. Serrell, C. S. Tainter, H. F. Watts, Townsend Wolcott, A. P. Wright.

These names embrace all that is representative in the various departments of electrical research and practice, and show how closely the paper is kept in touch with the best thought and the best work.

The little editorial rooms, then, are more distinguished, as we have said, by what comes out of them than by their intrinsic interest. Still the visitor will observe, perhaps, this plaster replica of the Powers sculpture of Morse, or the fine terra cotta bust of "Tom" Edison; or will handle with curiosity some sections of the earliest submarine cable, or the latest "high insulation" line wire for arc circuits, or some old photograph of a pioneer electric railway, or a bit of a new storage battery plate.

One word more as to the commercial side of editorial work as it affects the reader. We sometimes hear a friend say: "Yes; I receive such and such journals, but I can never find time to read them." A more serious mistake than this of never finding time to read at least the leading high-class journal of his profession can hardly be made by an intelligent man, and such neglect has actually been attended with serious financial loss. It is not the successful, progressive business man that makes this admission of not finding time, for he realizes that the vital prosperity and success of his calling are entirely dependent on his ability to keep abreast of the march of improvement, which can only be accomplished by carefully reading the descriptions and suggestions contained in his technical journal. So true has this appeared to one gentleman who in less than five years has made a name for business capacity that has won him many admirers of high standing in the business world, that he not only subscribes for a copy of The Electrical World for himself, but for each of his superintendents or heads of departments, and then observes that each copy is carefully perused. His method and reasons are simple: "I run systematically over each item from the front cover to last page, including every advertisement, and make notes of points of interest, and then converse with my respective assistants regarding the advisability of making either a change in the style of a certain class of goods, or of laying in a stock of some new articles just advertised, or of endeavoring to secure the trade of a newly organized company, and so on. Then every new name is carefully noted under a proper heading in our address book and correspondence is opened at once, and when one of our traveling men visits that point he collects all the available information regarding the prospects and financial standing of the party in question, and an abstract of his report is entered opposite the name in the address book. Thus we can quickly form an opinion regarding the advisability of holding their trade. My staff fully realize the value of being thoroughly posted on all new ideas, and know full well that were they to neglect their own interests by slighting the opportunity thus offered, they would be passed over by a more active, progressive subaltern when the question of promotion arose. Of course it takes time to go through a large journal thoroughly, but it is time well spent." That gentleman understands that the columns of a journal of good repute afford ample scope to the experimentalist and the inventor to describe the results of labor and to dilate on the reasons why certain action is accomplished; for the advertiser to lay before the reader whatever he has to offer; for the practical electrician to show the masterly manner in which some vexed problem has been solved; and last, for the correspondents to bring in their letter budget of news showing the progress of trade or enterprise in their various localities, the formation of new companies for transacting a lighting, power, or supply business, and all minor matters of interest to the electrical or allied industries. The news of the world is on the desk of the business man. He selects that which is of value to himself, and indirectly but quickly converts it into the dollar, and one mission of the journal is accomplished.

Just beyond these rooms are the quarters of the Advertising Department, which has charge of a very important division of the work. It goes almost without saying that when the subscription to a journal barely pays for the white paper it is printed upon, there must be other sources of income, and these are found legitimately in the advertisers who wish to place before the community their various wares and to expatiate on their merits. The advertiser who intrusts his business to a reputable journal knows that he is always sure of a good audience, and thus in an easy manner he achieves the highly difficult feat of securing the ear of the public. Hence, it is that The Electrical World is so crowded every issue with the announcements of representative houses and companies in all the lines of industry directly or indirectly connected with electrical applications. There is much detail work associated with the various advertising contracts, and all has to be done with the utmost care. This page "ad" is to go in the paper every week, and that once a month. Brown is anxious to get his "quarter page" right under Smith's, while Jones is only happy when his "1 in. d. c." is separated from Robinson's by at least fourteen pages of reading matter. This "card" is to be "set up" as "neatly as possible;" but the zealous merchant who sent in that one has a yearning for "prominent display" that nothing short of bill poster type will ever satisfy. All these peculiar requirements have to be borne in mind, and of course are cheerfully acceded to, so long as justice to all is secured and the general appearance of the paper is not injuriously affected. Now and then some mistaken individual has to be convinced that he did not buy the whole paper when he paid for an inch space in its advertising columns; but as a rule the advertising of the modern business houses is in the hands of men who know what they want, are willing to pay a good price for value received, and are reasonable to a degree in their demands. It is a fact worth a bushel of arguments to such experts that they secure certain results in the end as the outcome of their advertising, and they know, too, that it is persistence rather than temporary sensation that does them the most good. They know that the manufacturer who is a small advertiser has a small trade, and that invariably a large business accompanies large advertising. They do not, therefore, make sudden splurges and then fall back alarmed at their own audacity; but all the time, the year around, they insist on claiming the public attention in such a manner that they cannot be forgotten, but must be thought of at once by the prospective buyer and consumer. They have mastered the science of advertising, and it need not be wondered at, therefore, that they and the Department we are speaking of are always freely exchanging "points" and "wrinkles" for mutual benefit.



IN THE COMPOSITION ROOMS AND PRINTING OFFICE.

Opening out of the library is the Patent Department, which, by the way, has its own snug little library, containing among other things a complete and valuable set of the specifications and drawings of every one of the electrical patents issued by the United States Patent Office since its foundation, as well as complete sets of the *Patent Office Gazette*, reports and decisions of the Commissioners of Patents and the like. In the inner room is the manager of the Patent Department busily engaged with a pale, big-browed inventor, who glances round nervously as we peep in, and half conceals his plans with his hand, as though afraid we might appropriate the new ideas that have cost him so much in the loss of sleep, the long, weary experimenting, the outlay of money, and possibly even in privations bravely undergone. But he need not fear. His confidences are sacred. He is probably an electrical inventor, for the Patent Department makes a specialty of electrical cases. He has our warmest good wishes, and if he has something the world wants, it will not be long before its value and utility are recognized. He is simply doing his duty in protecting the product of his brain, and there are many chances in favor of his reaping a rich reward, as such kindred spirits as Morse, Edison, Brush, Weston, Elihu Thomson, Sprague, Bell, Moses Farmer, Van Depoele, Tesla, Field and others have done before him.

Immediately adjoining the Patent Manager's room is the Drafting Department, where are prepared the drawings to accompany the patent specifications. As the reader probably knows, the United States Patent Office wisely requires all drawings to be made uniformly of a certain size in a general style, and a case is facilitated and expedited that goes to Washington perfect in these respects. This department also does occasional work for the editorial staff in making sketches necessary to bring out more clearly the point of some minor article. We have now made the tour of the publishing offices, and will have formed a pretty good idea of the manner in which THE ELECTRICAL WORLD and its allied enterprises are conducted. As we leave we will take with us a few interesting circulars relative to the electrical business and its statistics, and a copy of this "Catalogue of Electrical Books," which hints forcibly at the remarkably rapid manner in which electrical literature has increased during the last five years, chiefly in works that deal with the theory of electricity or with the applications of dynamic currents. And as we reach the ground floor we will not forget to spend a moment in the beautiful dynamo and engine room, from which goes out the current to the hundreds of lamps all over the vast building.

FILING AWAY THE "CUTS" FROM THE PAPER.

In addition to the spacious offices of which we have been speaking above, THE ELECTRICAL WORLD has large mailing and store rooms across Nassau street, in the building of the Religious Tract Society. Communication is maintained by means of a mechanical telephone line, and all orders for books, papers, etc., are thus filed and filled as soon as received. Piles of books surround us on every hand, some just in from the binder's or from abroad, and others on their way to purchasers all over the country. In this corner an effort is being made to work off a long list of orders for the "Dictionary," and in another the books for a large miscellaneous order are being collected from their respective compartments. In these store rooms are kept also all the blocks of the illustrations used in the paper or in the book publications of the company. In the paper alone there appear about 1,500 cuts every year. These require no small storage space, but they are all carefully and ingeniously disposed of, and in connection with a recording system that enables any number of them to be picked out at once should a demand arise, as it sometimes does. The cuts in question are all kept in racks as shown, divided up into thousands of small compartments, each taking a block; or, if unusually large or otherwise noteworthy, they are laid aside, alphabetically arranged in large, flat drawers.

If the visitor be not weary yet, there are further ramifications of the business to be studied, and we might take him through the type-setting rooms, where the busy compositor silently fills his "stick" with type, and breathes his fervid anathema on the writer who cannot explain himself without a profusion of mathematical formula; or we might take him into the rattling printing office, where the fingers of the presses clutch insatiably for the piled-up sheets of paper, and then toss them off one after the other with a flick and a dab, until the tender comes at last to carry away the accumulation to the bindery. Perchance it is the day before the paper is mailed, and if so the visitor may secure a copy of the issue hot from the press, the first of thousands of readers to learn "what the WORLD has in it this week."

It is in the press room that the opportunity occurs

PREPARING BOOKS FOR THE MAIL.

THE BOOK STORAGE DEPARTMENT.

WESTERN BRANCH OFFICE OF "THE ELECTRICAL WORLD," CHICAGO.

to make or mar the reputation of a journal for excellence of illustrations. The Electrical World has always been noted for the beauty, finish and profusion of its cuts. It spends large sums of money on wood engravings, pen and ink sketches, and process blocks of all kinds. An issue of the paper contains on an average 30 illustrations, some of which are often full-page, and now and then occupy two pages. But however much time, money and skill were spent on these illustrations, it would all be wasted if there were lack of care and vigilance in the press room; so that the pressmen are given ample time to prepare the mysterious "underlaying" and "overlaying" by means of which, applied to the cylinder of the machine, the finest lines of the cut are brought out with the necessary clearness and delicacy. It is a slow, laborious process, and the editor who has driven things in order to get a big issue promptly to press chafes at the delay; but he is consoled by the knowledge that if the work is well done, it will be more than compensated for in the clean, bright, attractive appearance of the whole edition and the perfection with which the skill of the artist is brought out.

It is true that The Electrical World is published in New York, but it does not consider itself a local New York paper. Its contents are printed in English, because that is the dominating language of the globe; but in other respects, while proud of every good thing American in electricity, it aims to be above all cosmopolitan. A scientific journal may well avow a sentiment of patriotism, but it needs no politics and must be free from provincialism. All that The Electrical World cares to know is that an invention or idea is good; the nationality of the originator goes for naught, except that it is believed that in America the new things in electricity are accorded the fullest, warmest and most substantial recognition. Thus it is that the paper has its correspondence and news from abroad, and that no small portion of its contents is foreign in origin; so that the readers get a complete survey and condensation of all that is of interest in any quarter whatsoever. With respect to its position at home, it may be pointed out that The Electrical World is not less well known and well circulated in Boston and San Francisco than it is in Chicago and New Orleans. In order to make full record of the events in electricity in this country, the company has its correspondents in every city of importance, and it maintains, moreover, its own regular branches in Boston, Philadelphia and Chicago. It is a matter of common knowledge that the electrical progress and movement in those cities and the regions tributary to them is best represented in the columns of the paper week by week. These branch offices, conducted by able and experienced managers, serve also as bureaus of information, and are largely resorted to by the local and traveling members of the electrical community.

THE PHILADELPHIA BRANCH OFFICE OF "THE ELECTRICAL WORLD."

NEW ENGLAND BRANCH OFFICE OF "THE ELECTRICAL WORLD," BOSTON.

The following is an extract from an article printed in The Electrical World some years ago, and it is just as true to day as it was then, the lapse of time having but served to give it greater force and emphasis:

"The World permits no limitation of its range or sphere of work, but is alive to the development of electricity in every department, and has its readers as well in China as in Africa, and not only in Asia Minor and India, but in every section of North and South America—in short, wherever throughout the world there is interest felt in electrical matters—wherever the telegraph, the telephone, the electric light, the electric motor, the storage battery or any other kind of electrical apparatus is in use."

It may interest the reader of these pages to know how completely the subscription list of The Electrical World encircles the globe. In the New World it has subscribers in every State and Territory of the United States, as well as in every section of Canada, including New Brunswick, Nova Scotia and British Columbia; also in almost every State of our sister republic of Mexico, including even far-away Yucatan; and in Guatemala, Honduras, San Salvador, Costa Rica, the Argentine Confederation, the new Brazilian republic, the United States of Colombia; also Chili, Peru, Venezuela, Demerara, as well as in Cuba, Jamaica and other West Indian islands.

In the Old World it is mailed regularly to subscribers in England, Ireland, Scotland, Belgium, France, Germany, Holland, Denmark, Norway, Sweden, Finland, Russia, Poland, Austria, Hungary, Switzerland, Italy, Spain, Portugal, Madeira, Gibraltar, Greece, Turkey, Egypt, Abyssinia, Arabia, Mozambique, Natal, Orange Free State, Cape Colony, the West Coast of Africa, Hindoostan, Burmah, the Straits Settlements, Malay Peninsula, Java, Phillippine Islands, West Australia, South Australia, Queensland, New South Wales, Victoria, Tasmania, New Zealand, China and Japan, which makes a pretty complete circuit of the earth, and shows the interest taken in the progress and development of electrical matters in America in countries where one would hardly expect to find an electrical journal.

The Knapp Hotel Annunciator.

Our readers will find an illustration on this page of a handsome piece of hotel office furniture lately shipped to a western city by the Knapp Electrical Works, of Chicago. This company has long made a specialty of the Knapp combined fire alarm, guest call and hotel annunciator, and, thanks to the simplicity of working parts, has constructed several hundred that are now in use in various hotels, the frames of the majority being of special design and of expensive woods, such as mahogany, rosewood, antique oak, etc., that harmonize with the interior decoration of the office. The light battery current required, the absence of all complicated parts and the rapidity with which the needle assumes the vertical position on the closing of the circuit, all combine to make it a desirable instrument.

For house use a smaller annunciator is made, as well as a burglar alarm, both of which are of the same high grade as the hotel annunciator, and the working parts of which are often placed in cases of special design, where supply dealers prefer to furnish a special instrument to their local trade.

The Design of Commercial Transformers.

BY J. SWINBURNE.

III.

We may now work out an example of a closed circuit transformer.

Suppose we have to make one to give 100 volts and 50 ampères in the secondary, with 2,000 volts in the primary with a frequency of 80 per second. We may, for the present, assume that there are certain sizes of punchings already settled; more will be said later on the proportions of the punchings. Suppose the punchings to be as in Fig. 9, the dimensions being in centimetres. There are then 28 square centimetres available for wire. Taking 800 ampères per square inch, or say 120 per square centimetre, as a convenient current density, the secondary will take wire a quarter of an inch, or 0.635 centimetre square. Allowing for the insulation of the wire, this takes up 0.485 square centimetre. The primary may be at the same current density, No. 16 B. W. G. of 0.165 centimetre diameter bare. With insulation this takes up 0.05 square centimetre ; so one turn of secondary with 20 turns of primary take up 1.485 square centimetres. As there are 28 square centimetres available, this would allow 18.8 turns of primary. Some room must be left for the insulation wrapped round the coils, for unevenness in the winding, and for the turns not coming out in convenient whole numbers of layers. It is not necessary for us to work these details out ; here we may take 16 turns of secondary as allowing a reasonable margin. We thus have 16 turns of secondary and 320 primary; and can find the length of the transformer from the formula $E = 4\ A\ B\ N\ T \times 10^{-7}$, where A is the cross sectional area of the core. Allowing an effective induction of $B = 10{,}000$, this gives 24.4 centimetres, or, say, 25 centimetres.

We may now work out the performance of the transformer. The loss may be divided into loss in the iron and loss in the copper. The former is made up of two parts, the loss by reversal of magnetization, and the loss by Foucault currents. The loss in the copper at full load can be got from the formula $W = p\ c\ t\ d\ l^2$, where p is the specific resistance of copper, $c\ t$ is the ampère turn, d the current density per square centimetre, and l the average length of each turn. The specific resistance of warm copper may be taken at two microhms. The ampère turns in the primary and secondary together are 1,600, and the current density is 120, so there are 31.5 watts lost in the copper. If the current densities in the primary and secondary had been different, they would have to be worked out separately and added together. As the loss in copper is only 31.5 watts at full load, and the power taken by the transformer is thus 5031.5 watts, the drop is

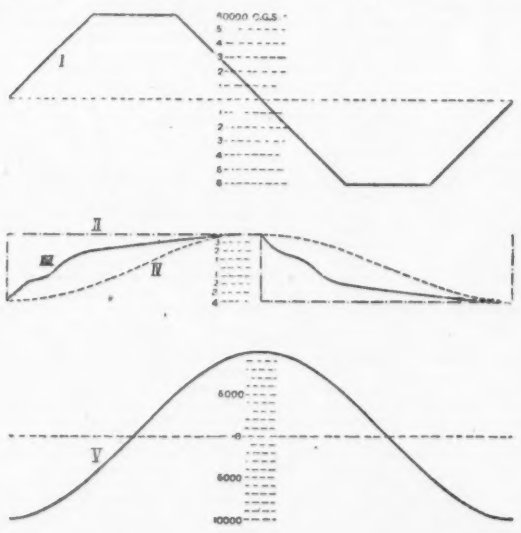
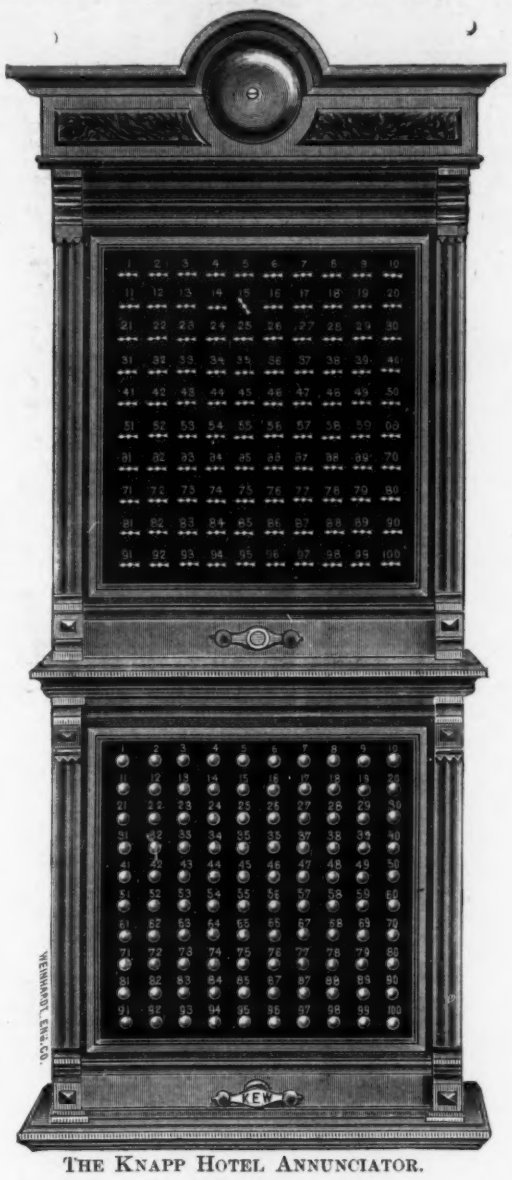


FIG. 10.—THE DESIGN OF COMMERCIAL TRANSFORMERS.

only 31.5 in 5031.5, or 0.625 per cent., or less than one volt on the lamps. The loss in iron by reversal of magnetization may be taken at 4,800 ergs per cubic centimetre per period. There are 7,600 cubic centimetres of iron, so the loss is $7{,}600 \times 4{,}800 \times 80 \times 10^{-7} = 292$ watts. The loss of power in iron by Foucault currents may be reduced as low as 60 or 100 watts in such a case without difficulty. Taking it at 80, the total loss in the transformer comes out 372 watts. This gives a full load loss of power of 7½ per cent., or an efficiency of 92½ per cent. If the transformer, which is capable of supplying 84 60-watt lamps, is in a house which is wired for, say, 100 lamps, it is not likely that it will be called upon to do more than to light an average of, say, 60 lamps for six hours a day at the most. The loss in the copper when lighting 60 lamps is 16 watts; the loss in the iron during the whole 24 hours must be condensed into the six hours to give a comparison; so the loss in iron must be taken at 1,500 watts. This gives an average efficiency of 77 per cent. In this estimate a great deal depends on the time the transformer gives a reasonable output. Some authorities go as far as to say that the average is only equal to all the lamps for which a house is wired running 1.1 hour out of 24. If we take 1.2 hour of full load, the loss in iron is equivalent to 7,450, so that the average efficiency is 40 per cent. This is probably an exaggeration. It shows, however, that the proportions of iron and copper in the transformer under discussion are very far from being the best, though they are as nearly as possible those in common use. It would be better, especially in the case of a transformer for house lighting, to employ a much smaller core, which would, of course, involve more turns of copper.

The magnetizing current in a closed circuit transformer is small, but it may be worth while to investigate it, and



THE KNAPP HOTEL ANNUNCIATOR.

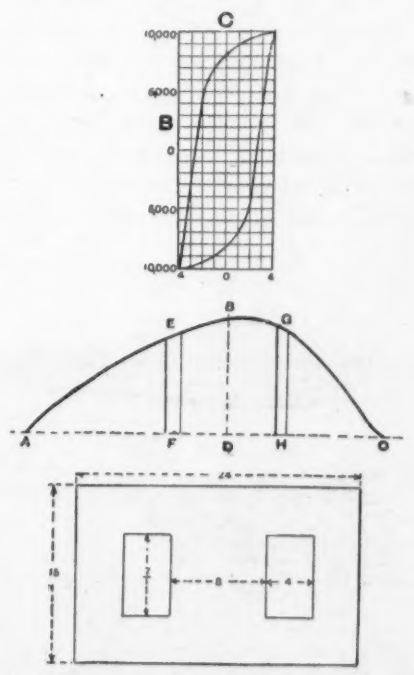
see if there is any correspondence between the loss of power in the iron and the product of the effective electromotive force and current. As the back electromotive force of the transformer at any instant varies as the rate of increase of the induction, the maximum induction $B \propto \int E\ dt$, so that the maximum induction depends on the mean electromotive force, and not on the root of the mean square. We want to know, then, the relation between the mean and effective electromotive forces. Suppose the electromotive force curve was as shown in I, Fig. 10. It is not pretended that the electromotive force curve has these sharp corners ; this figuration is chosen merely for the sake of simplicity. The ratio of the effective electromotive force to the mean is, in this case, 1.115. If it were a saw-tooth curve—that is to say, if the tops were not flattened—the ratio would be 1.148. This is an extreme case; the top must be somewhat rounded over in practice. If it were a sine curve the ratio would be 1.11. We may, therefore, safely take 1.1 as the ratio, for a large variation in the form of the curve makes comparatively little difference. If an error of 2 per cent., which seems to be about the outside, were involved in this assumption, it would lead to an error of a little over 2 per cent. in the loss of power taken by the transformer, and the error would be 0.2 per cent. in the efficiency of the transformer, and this is much less than the margin in most practical tests.

Instead of taking the transformer under discussion, we may, to secure simplicity in discussion, imagine a special case. Suppose a ring-choking coil, with a core of 1 square centimetre section, and a maximum induction $B = 10{,}000$. Suppose this induction needed a magnetic force of 5, the maximum current would be 4 ampère turns per centimetre of core. We may assume that there is one turn of wire per centimetre with 4 ampères as a maximum current; and we can consider this turn by itself, without reference to the rest of the choking coil or transformer. Assume, for simplicity, a frequency of one period per second. As the maximum induction is 10,000, the mean back electromotive force on the turn is 40,000 centimetre gramme seconds; the area of the curve of electromotive force must then be 40,000. V, Fig. 10, is then the curve of induction. If the permeability of the iron remained constant, so that the induction varied as the ampère turns, the curve of current would be as shown in IV, Fig. 10. The curve of magnetizing current does not resemble that of the electromotive force, and it lags behind it a quarter of a period. The power is found by drawing a curve of the products of the ordinates of the two curves. When both the ordinates are on the same side of the base line, the work may be taken as positive, and when on different sides, negative. It is clear that in this case the neighboring quarter periods balance each other and cancel out, so that there is no power absorbed by the iron. This must be so, whatever the relation between the magnetizing force and the induction, provided it is the same when the induction is decreasing as when it is increasing. If the induction does not fall with the magnetizing current, but lags—that is, if hysteresis takes place—the current curve is no longer symmetrical. For instance, if it is as III, the energy absorbed during the second quarter of the period is greater than that given out during the third, and the energy absorbed during the last quarter is greater than that given out during the first. The balance is wasted in the iron, being converted into heat. The form of the curves showing the relation between the magnetization and the magnetic force is familiar to most readers. The area of the curve is generally given as $\int I\ dH$. In this form it is dificult to give it any physical interpretation that helps us. We may change it into $\int H dI$. Instead of I write $B/4\pi$, and instead of H write $4\pi C$, where C is current, in centimetre gramme seconds, and we have $\int C\ dB$. The induction is a trifle more than 4π times the magnetization, but that only alters the form of the curve a little and does not affect its area. In the case under discussion, of course, the permeability is so high that B is practically equal to $4I$. We may write $\int C\ dB = \int C \frac{dB}{dt} dt = \int CE\ dt$, so that the expression is the current integral of the electromotive force. In this form the energy is in the more familiar shape of watt seconds.

Assuming, then, for the moment, that I, Fig. 10, is the curve of electromotive force, the curve of induction can be plotted, as in III. The ordinate at any point of V is proportional to the area of the electromotive force curve I taken up to that point. If the magnetizing current were proportional to the induction, the current curve would be the induction curve drawn to a different scale as IV. The current in curve IV lags behind the electromotive force a quarter of a period, and, as already explained, no power is absorbed, because any two neighboring quarter periods balance each other. This is easily seen when the electromotive force curve is symmetrical, for whatever function the magnetizing current is of the induction the quarter periods are similar and cancel out, provided the current is the same function of the induction whether rising or falling.

Suppose, however, that the electromotive force curve was as in Fig. 11. As the maximum induction is proportional to the maximum area of the electromotive force curve the top of the current curve coincides with the zero of the electromotive force curve. As the magnetizing current changes from its maximum value in one direction to its maximum in the other during the half period, or while the electromotive force area $A\ B\ C\ A$ is described, it passes through its zero value when half the area is described; $A\ B\ D\ A$ is, therefore, half the area of $A\ B\ C\ A$, and is equal to $B\ D\ C\ B$. Suppose these areas are divided into a number of vertical strips of equal area. Take any pair of strips $E\ F$ and $G\ H$ which correspond, when counted either from D or from A and C. As the area $A\ E\ F$ is then equal to the area $C\ G\ H$, the induction at the times or phases F and H is the same, and if the current is the same function of the induction, whether rising or falling, the current is the same. The work done in the times represented by the breadths of the strips is thus equal, but as the current is in opposite directions, the energy cancels out in the neighboring quarter periods. If there were hysteresis, the current corresponding to the strip $E\ F$ would be less than that corresponding to $G\ H$, so that energy would be given to the transformer.

Returning to Fig. 10, we may plot the magnetizing current having the relation of C to B given by the curve, Fig.



FIGS. 12, 11 AND 9.—THE DESIGN OF COMMERCIAL TRANSFORMERS.

12. The current curve III is found by plotting the value of C for every value of B. The effect of hysteresis is then to lessen the lag of the magnetizing current, so that power is absorbed by the transformer. If I had been a sinoidal curve, so would V and IV, but III would depart widely from it. As the only thing for which we want to know the forms of the curves in studying transformers is to investigate the loss of power due to hysteresis, it is of no use to assume that the magnetizing current is sinoidal, as that would lead to large errors. The curve of sine assumption thus breaks down in the only case in which knowledge of the curve might be of any use. Mr. Blakesley has introduced a very ingenious method of measuring loss of power by means of two dynamometers; and the efficiencies of transformers have been measured on the curve of sine assumptions, but the results are hopelessly inconsistent with themselves, sometimes showing a negative loss in the iron, as if it gave out power and assisted the dynamo.

If the hysteresis were as great as possible—that is to say, if the curve, Fig. 11, were a rectangle, bounded by its extreme co-ordinates—the current curve would be as II. There is then no lag at all of the magnetizing current. The

mean current and effective current would be the same. As the mean electromotive force is 10 per cent. less than the effective, the power obtained by multiplying the effective current and electromotive force together must be reduced 10 per cent. to give the power absorbed by the magnetizing current. Throughout the range of inductions generally used in transformers, the area of the curve of C and B is, according to Professor Ewing's readings, only 0.42 of that of the containing rectangle; so we may take 0.38 times the apparent power as the real power absorbed by the iron at no load. It must not be forgotten that we have made three assumptions. The first was that there are no Foucault currents, which is generally unwarrantable. The second was that the mean force is 0.9 of the effective electromotive force, which is probably nearly right. The third was that the ratio of the area of the curve of C and B to the area of the containing rectangle is independent of the speed of reversal. It may be safer to allow a larger percentage than 38 to allow for this. If the core is made of plates about 35 B.W.G., or say .025 millimetre thickness, it may be more than safe to take half the apparent waste of power at no load as correct, thus allowing a margin for Foucault currents. Foucault currents synchronize with the primary electromotive force, and act as if a secondary was closed through resistance, so they increase the percentage.

The magnetizing current has been discussed at length to show how it is affected by hysteresis, and to show how the apparent and real power are related. The latter consideration is very important in connection with dynamos at central stations. In designing a transformer it is much easier to find the waste of power from the volume of iron and the waste per cubic centimetre. The loss by Foucault currents can generally be taken in the same way. The testing of a finished transformer is another matter, which will be dealt with later.

The loss by Foucault currents can be reduced to any desired extent by laminating or using fine wire: but the plates must be very thin to make it really negligeable.

The Foucault heating in punchings of sheet iron cannot generally be calculated, but it is near enough for our purpose if we take circular punchings like dynamo discs of about the same size. For instance, instead of punchings in our example, we can take washers of 3.5 and 6.5 centimetre, internal and external diameters. The power lost in a disc by Foucault currents is

$$P = \int\int \frac{8\, B_v^2\, 10^{-16}\, n^2\, t^2\, \pi\, r\, dt\, dr}{R};$$

or

$$\frac{8}{3\,R}\, B_v^2\, 10^{-16}\, n^2\, t^2 \text{ per cubic centimetre.}$$

To give a Foucault current loss equal to one-fifth of the hysteresis loss, with an induction of 10,000 and a frequency of 80, needs sheet iron .0225 centimetre, or just over No. 35 B. W. G. Of course, there are similar losses in iron cored dynamos.

Take a piece of wire 1 cm. long, of radius r. The virtual E.M.F. on any elementary layer is $4\,B\ r^2\,\pi\,n$, and the resistance of such a layer is $\frac{2\,\pi\,r\,\Omega}{d\,r}$, where R is the specific resistance of warm iron, say 10 microhms. This gives the power $\frac{2\,B_v^2\,10^{-16}\,n^2\,\pi\,r^4}{R}$ in the little piece of wire. There are $\frac{1}{4\,r^2}$ pieces per cubic centimetre, so the watts per cubic centimetre $= \frac{B_v^2\,10^{-16}\,n^2\,\pi\,r^2}{2\,R}$. To reduce he Foucault current heating to one-fifth of the hysteresis heating at an induction of 10,000 with 80 periods per second needs wire 0.6 centimetre in diameter, which is between Nos. 24 and 23 B.W.G.

Reverting to the example of a transformer worked out in Fig. 9, the efficiency can be increased by altering the proportions of iron and copper. This subject has been treated at length in a paper read before Section G of the British Association this summer;* so the reader may be referred to that paper. The best proportions are there worked out for square sections of core and of coils. There is little loss of efficiency when these sections are widely departed from, provided the relative proportions are kept approximately the same, and better ventilation is thus secured.

The Institute Discussion on Transformers.

We give below the discussion had on Prof. H. J. Ryan's paper on "Transformers," read at the last meeting of the American Institute of Electrical Engineers, and published in our issue of Dec. 28, 1889:

Mr. Townsend Wolcott: Did I understand Prof. Ryan to say that the loss of energy is necessarily less where there is mechanical vibration?

Prof. Ryan: It seemed to us to have been so in this transformer; but we are not sure of it.

Mr. Walcott: On the supposition that it is so, where does the energy come from? The idea is that the reversal of polarity of the iron absorbs a certain amount of energy in any case—is it not?

Prof. Ryan: The idea I suggest amounts to this, that the energy that was taken up in shocking that iron was less than what was saved in the hysteresis. That is, the hysteresis was made less by a greater amount than the energy that was spent in shocking the iron.

Mr. Wolcott: That is the way I understood it; but is there any explanation why that should be so?

Prof. Ryan: Not that I know of. I have not thought of the matter to any great extent, or further than I have suggested.

Mr. Nikola Tesla: Professor Ryan has said that the form of the primary current wave departed considerably, under certain conditions, from that of the primary electromotive force, and he also stated to what he thought this departure due. I think that this departure of the primary current wave from that of the impressed E. M. F. is due, to a considerable extent, to the conditions of the secondary circuit of the transformer, and I regret that Professor Ryan has not shown in the secondary an inductive resistance instead of the lamps. I think that then there would have been found a still greater departure of the primary current from the primary electromotive force. If we close the secondary circuit through a non-inductive resistance, such as lamps, it diminishes the lag of the primary. If we close it through an inductive resistance, it increases the lag of the primary. In this way two effects may be produced: First, the primary current wave will depart more or less from that of the electromotive force; second, the secondary electromotive force will lag behind the primary electromotive force, as Professor Ryan has found.

Prof. Ryan: I would like to ask Mr. Tesla how he would produce that inductive resistance in the secondary circuit?

Mr. Tesla: When you close the secondary circuit through the resistance, suppose that you put a coil of wire in the circuit instead of the incandescent lamp.

Prof. Ryan: Would you not be increasing the hysteresis effect in that way? It seems to me that then just what you say ought to follow. Of course, it should be understood that the stress is laid merely on the fact that there is a certain component at all times, flowing to keep up the magnetism; but, aside from that, whatever current passes is merely the opposite of that which passes in the secondary circuit.

*See The Electrical World, Oct. 5, 1889.

Mr. Tesla: You stated that this departure was due only to the hysteresis.

Prof. Ryan: Suppose that you introduce hysteresis in the secondary circuit, and thereby augment the irregularities of the primary circuit; is it not after all ultimately due to the hysteresis?

Mr. Tesla: But, suppose, instead of the incandescent lamp you use a coil of inductive resistance, which would take the same current as the lamp? When you use any device by means of which you introduce hysteresis in a secondary circuit, do you not greatly augment the displacement of the primary current? Of course as we load the secondary with lamps, the primary comes closer and closer to where it ought to be; and I think if you had made a trial with an inductive coil in the secondary circuit, instead of the lamps, it would have shown some interesting conditions. I believe Professor Ryan stated that the secondary electromotive force commenced at a given point to lag behind the primary electromotive force?

Prof. Ryan: Of course it is gradual.

Mr. Tesla: Have you not noticed, for instance, when this takes place that it began suddenly?

Prof. Ryan: No; I have not noticed that it began suddenly.

Mr. Tesla: I should say that when the secondary circuit has a different retardation from that of the primary circuit, then this condition begins. That is to say, if you have a primary coil, and you pass the current through that coil, and you have the secondary circuit closed, you then observe a certain lag of primary current. Now, if you add in the secondary circuit an inductive resistance, you can cause a still greater retardation in the primary; and if you diminish the retardation of the secondary by inserting lamps, you diminish the retardation of the primary circuit to a greater extent than that of the secondary, thus in both cases causing the secondary electromotive force to lag behind the primary.

Prof. Ryan: I would like to say that Mr. Merritt and I intend to continue our work in this line, but, of course, we wish to vary the circuits upon which we experiment. As soon as we have done this work on the transformers we expect to take up the action of the condenser in all its relations to circuits possessing induction, and to circuits not possessing induction, and we will test this matter which Mr. Tesla has just spoken of by working a coil in the secondary circuit, instead of a lamp. I think that a great deal is brought out in this way, and that one would be able, by careful study, to predict fairly well what would take place by varying the conditions.

Mr. A. E. Kennelly: There are two points about which I would like to ask Professor Ryan. One is with reference to that very distorted curve that we see upon the first sheet, representing the values of the electromotive force and currents when the secondary is open. I understood Professor Ryan to say that the square root of the mean square of the primary current corresponding to that distorted curve did check with the average of the square roots of the ordinates as compiled in the series. Now that statement, supposing it to be rigidly accurate, is tantamount to an assertion that the primary curve, which looks so distorted, has really the position of two sine curves; because if I mistake not, the sine curve is the only curve which possesses the property that the square root of the mean square should represent that average. It would therefore mean this: That the primary current, starting under the impulse of that primary impressed electromotive force (which we will assume to be a true sine curve) shall meet with an opposing force, which is of itself a sine curve. I think it is important to know whether that is so or not. I think it would also be interesting to know how far the observations before us show whether the impressed electromotive force is of a true sine nature or not. We know that it approximates to it in a great number of cases; and we know also that in alternating current dynamos the curve is by no means of a true sine type. It is fundamental in the whole subject we are studying to know how far the deviation is from the theoretical sine curve, which we have before us.

There is one question of very great importance in every point of view, and that is the question of hysteresis. We know, when we take a converter, that we can measure the amount of energy which it absorbs in a given time; and we can measure the amount of energy that it delivers in a given time. We have then to deal with forces which are present in producing the balance of energy absorbed by the converter uselessly; and those forces must belong to one of the two conditions; the one, a purely frictional resistance to the current, whereby the energy is transformed into heat; and the other, the effect of the magnetism there is in the current, producing the magnetic lag. It is of the very highest importance that we should always be able to separate those two forces; and the paper before us gives very important suggestions by means of which we can carry that differentiation into effect. The Foucault currents can be reduced sufficiently by diminishing the mechanical cross section at any one point, and we know that in good transformers the current can be reduced to a minimum; but what we do not know is the quantity of energy which is being absorbed in the hysteresis under the conflicting conditions of mechanism which are perpetually occurring.

In civil engineering we are brought face to face with the wonderful fact that a very large portion of its application and design lies in the general knowledge of the properties of the molecules of iron in the different conditions in which that iron is used; and the mystery grows more and more when we remember that in electrical engineering it is not so much the mechanical properties of iron in the mechanical engineering sense, as it is the magnetic properties of iron, which concern us, and which vary perpetually, in every design of apparatus; because, after a piece of apparatus has passed from the stage where this wonder is no longer new, then the question comes, how much can we economize and save out of a given mass of iron or copper? And the question, which is coincident upon that, How much we can save or waste, if hysteresis in iron becomes of greater and greater importance?

In hysteresis we have two distinct things to deal with: first, we have the fact that the iron will not return immediately to its previous condition after some magnetic effect has been impressed upon it; and, secondly, that it has a frictional resistance, and cannot instantly obey the reversed force. In all slow working transformers, in all pieces of apparatus where the changes are slow and steady, we can generally neglect what is called the frictional hysteresis due to speed, and simply take the static hysteresis; and it becomes of the very greatest importance that we should be able to distinguish between the statical hysteresis and the frictional hysteresis. With regard to the question asked as to the effect of mechanical shocks on hysteresis, I think I may suggest what may be a possibility, namely, that it is simply a question of how the magnetism, which has been left after a given impulse, can be shaken out; and as you can shake that magnetism out by any means, you will have that hysteresis destroyed. If you will study that hysteresis chart (see Fig. 11, page 420, Dec. 28, 1889) you will see that the area of that curve represents actually the amount of energy which is being consumed or delivered from the cycle in the iron through its magnetic effect; and if you can prevent that taking place, that lag would disappear, and the cycle would disappear also.

I think the question of the differentiation of the frictional hysteresis from the static hysteresis is one which has gone beyond experimental methods, and has become one of very great importance; and if words were necessary to recommend its importance still further, is it not enough to consider that apart from practical considerations it has also a very important scientific bearing? Because, by the way in which magnetism acts upon iron (the most completely magnetic substance we find in nature) the more readily can we guess at the principles which underlie the whole phenomenon of magnetism, and the more completely can we discriminate the different conditions under which that iron acts, the more truthfully shall we be able to guess at the conditions which nature imposes upon that iron. So that if any words were wanting to make the practical necessities of this point more clearly visible, surely this great necessity of early studying the interesting phenomena of the action of magnetism upon iron will regulate itself by its own emphasis, carrying its own force with it.

Dr. Wm. E. Geyer: I would like to ask Professor Ryan if any peculiarity was ever noticed about halfway up in the curve (Figs. 5, 6 and 7) of the primary electromotive force—I mean a sudden departure from that smooth curve at that point?

Prof. Ryan: Yes, as I think of it now.

Dr. Geyer: Last May and June there was made, under my general supervision, a very similar experiment, where, however, we used a condenser, and discharged the condenser through the galvanometer, and in that way measured the relative value of the electromotive force. We also got curves which were very smooth, indeed, (we took points more numerous than those that are drawn on that chart), until we got to about a point halfway up, where we obtained results which at first we thought were irregular and accidental. We skipped that part of the curve and went further up, when again it was extremely regular, until we got down on the other side to about the same height, where again this irregularity began. The irregularity was so precise that it meant to my mind that it was not a simple accident of the experiment. We then took special pains to determine points extremely near together just in that region, and, persistently, we would get a very decided jog in the curve; that is, a sudden upward motion and a sudden downward motion, at the end of which the perfect regularity of the curve began; and on the other side again there was the same irregularity and the same jog on the lower curve again. I have not found any explanation to satisfy myself as to what the cause of it is. If any could be offered by any gentleman present it might be interesting. As I said before, this departure from the regular curve every time we tried it, persuaded me that it is not a matter of faulty experiment, but that it must be there. I might mention, in addition, that when these same curves were determined on an open circuit, or on a non-inductive resistance, those irregularities were not noticed. They were only noticed when the transformer was a part of the main circuit.

Mr. Tesla: May I ask whether the machine was run at a constant number of alternations all the time?

Dr. Geyer: The machine was run at constant alternations, the regular commercial speed

Mr. Tesla: I think if the number of alternations had been varied, greater irregularities would have been observed. I think it will be found that if a higher number of alternations had been chosen, the irregularity would have been more pronounced, until a certain limit was reached. I have run them as high as 150,000 per minute. Where the alternations were very low the irregularity disappeared; but where the same number of alternations with a longer magnetic circuit in the transformer was employed, they would again appear. So that, as I know that the magnetic lag was varied by the length of the magnetic circuit, I assume that was the cause of the irregularity. Mr. Kennelly has very ably, and rightly, brought up the importance of the study of hysteresis. I think this is a field in which we should all work and achieve considerable improvement, so much so, that certain of my experiments have been rather surprising; and in investigating the cause of the lag of the iron we will find the experiments not only of value to the investigator, but of real value to us practically.

Mr. Joseph Wetzler: With reference to the remarks made by Dr. Geyer as to the cause of the notch in the curve, it seems to me that it might possibly be due to irregularities in the nature of the magnetic field, so that the current may have different intensities as the armature coil passes over different parts of the surface of the magnet. Thus if it is more strongly magnetic all around its edge than at the centre, that would be an irregular field which would cause a corresponding effect in the current produced, so that the curve would not be regular.

Mr. Mailloux: I am inclined to believe that the theory advanced by Mr. Wetzler is the correct one; and I think that the notch in the curve is accounted for by the dynamo, rather than by the reaction of the converter upon the impulse. The fact is, that in a dynamo we never have a uniform distribution of the lines of force, from the very fact that towards the centre the lines of force are less dense than in the area which is contiguous to the edges. The consequence is that when the coil is approaching the edge of the pole it is approaching a spot where the lines of force are more dense; and after it has passed that spot it finds itself in a place where the lines of force are not so dense. It again meets toward the middle of the pole a place or period where the lines are denser; and again as it comes to the outer edge, a place where the lines of force are dense. Now, if you bear in mind the fact that the lines of force are merely the exponents or indicators of the condition of the magnetic medium, showing that there is a highly elastic substance under great stress of tension there, then we may replace those lines of force by elastic substances; and you will find on theoretical reasoning that you would naturally expect that the action in the wire, the moment that it begins to have the current in it, would be reacted upon by the lines of force, and displace them at that point. We know that such is the case in dynamos for continuous current, but not with alternating currents. We know that the lines of force are distorted and thrown out of their course by the action of the current in the armature itself. Prof. Elihu Thomson has shown by experiments that there is such a crowding effect on the lines of force that, as a matter of fact, the area of the coil, or the contour of the coil, should for best results inclose a smaller area than the area of the pole possesses. I should imagine that the notch in the wave of the impressed electromotive force would be due to the fact that as the current approaches, it first meets with an obstruction which is too stiff for it to bend over, and therefore immediately cuts the lines of force, creating a high tension, which produces a higher electromotive force. Then we come to a place where the field is more uniform, and consequently we get the action which we would naturally expect, a current more nearly uniform, and at a rate more in accordance with some fixed law. Then as we come to the outer edge we must pass through another crust of the lines of force, and we would naturally expect to find another big break and a slight up-wave. Pursuing the same reasoning, you will find that this would take place just exactly as Mr. Tesla has found by experiment, and that the speed at which the alternations occur have a great deal of influence upon that. I should have myself expected that the lines of force, being like all electric substances, more brittle to a rapidly acting force, would show that effect more perceptibly at higher alternations than at lower ones.

Mr. Tesla: That opposition which was alluded to as occasioned by the dynamo machine might not have its cause in the machine; but that very kind of opposition may exist in the transformer itself; and there is where I believe it does exist. I was some time ago engaged in some work of getting direct currents from an alternating current, and I found that I was able to produce a preponderance of current impulses in one direction over those in another; and then I found that under certain conditions an opposition appeared, exactly as was stated by Mr. Mailloux in regard to the dynamo machine, and that such conditions can be brought about, and that they depend greatly upon the iron, on the number of alternations and the length of the magnetic circuit. Imagine, for instance, that you have in the magnetic circuit of the transformer magnetism in one direction set up; certainly, if such magnetism exists it will oppose the passage of a current of a certain direction and in this way a certain modification of the curve would be brought about

Mr. Mailloux: I am very glad that Mr. Tesla spoke of that, because I think he is undoubtedly on the right track. I might have gone further, and said that undoubtedly the same phenomenon would occur in the transformer core itself, and that there would be changes of magnetism there under different circumstances. The only other point I wish to advert to is in connection with some of these curves. I would like to ask Prof. Ryan whether, in connection with this work, he has taken the trouble to follow the concomitant variations of the values of the inductance; that is to say, the instantaneous values that we are supposed to get for the inductance at different variations of the electromotive force, so that we might be able to get a means of comparison between theory and practice.

Prof. Ryan: If I have understood Mr. Mailloux's question I will answer it in this way: That if you take what is the accepted theory up to date, as far as it has been elaborated, of the transformer, and which assumes always, I believe, that the relation of the currents and magnetism of the iron is the same giving an up curve as it is going down—taking that theory as it has been elaborated, and the suggestion which was made by Lord Rayleigh about a year ago—that is to say, taking the transformer and observing the relation of the magnetism of the iron corresponding to any particular number of ampère turns going up and coming down—you modify that theory (because it is not always the same); and when you have measured the difference that exists in going up and coming down, you will get exactly the state of affairs that are here found actually to exist. The suggestion that was made by Dr. John Hopkinson, in a note published in the Proceedings of the Royal Society a few years ago, made a faint suggestion that if you assume this curve and substitute for that curve a curve as modified by the values which you obtain in hysteresis, you will get precisely this state of affairs. One thing more with regard to the method by means of which you can express the exact shape of those curves mathematically, and therefore proceed by means of mathematical investigation, and by means of the impressed electromotive force that we have here given, to find what it is, and what should follow. I will say that Mr. Merritt has carefully analyzed the properties of those curves, and has shown that the impressed electromotive force curve is made up, in the first place, of a sine curve in unison with it and another curve of the third order running along like this (indicating), and, finally, one of the fifth order; and if we should carry it one further we should find with it one of the seventh order, in odd orders, the even orders having disappeared, or else the magnetism would be heavier on one side than on the other. But matters of that sort are very technical; and I did not think that those curves, representing the constituents of these various curves, would be of much interest, or I should have brought them with me.

Mr. E. G. Acheson: I understood Dr. Geyer, in speaking of the notch in the curve, to say that he obtained it only when he had the transformer in. That being the case, it could scarcely be due to the machine.

Dr. Geyer: The notches were not obtained when the dynamo was run on an open circuit.

Mr. Kennelly: In that case I venture to say that it must be due either to the magnetic lag or else to a variation in the self-induction. If the processes of self-induction were variable it might be expected. With such variations it is probable that such kinks would follow.

Dr. Geyer: Am I right in understanding Prof. Ryan to say that the efficiency of the transformer was 85 per cent.?

Prof. Ryan: Eighty-six and six-tenths per cent. when working with ten lights in the secondary.

Dr. Geyer: Was that efficiency tested also in some other way?

Prof. Ryan: No; it merely came in as a secondary matter. We had not time or we would have gone into the matter more fully.

Mr. L. B. Stillwell: The work that Professor Ryan has introduced to-night is in the general line that we have been working for two or three years. I had not intended to add anything to the discussion; but there is one point that I might mention which may

possibly be of interest, and that is, that we have noticed the point to which Professor Ryan referred in the case of a 10-light transformer, wherein he found that the loss due to the iron decreased as the load is added to the transformer. We have observed that this decrease is more marked in the case of a small transformer. In a 40-light transformer the iron loss is more nearly constant, and it seems to me that this fact is in the line of the explanation which has been suggested as to the shaking out of the magnetism, and the consequent decrease of loss in iron at heavy load in small-sized transformers, as larger ones would be somewhat less liable to mechanical vibration.

If I have understood the diagrams correctly, there is one other point which differs slightly from the observations I have made, in which observation, however, I used the divided electro-dynamometer method of measuring the angle of lag. Of course that method is based upon the assumption that these are sine curves. Applying that method, we have found that the lag factor or cosine is somewhere in the neighborhood of 70 degrees; and as load is added to the secondary, the factor increases rather more rapidly than shown by the curves that Professor Ryan has drawn. For example, with five lights on the secondary I have found that the primary and secondary currents are practically 180 degrees apart, the cosine of the angle of lag being about 98 degrees. The discrepancy may possibly be due to the irregularity of the primary current, as Professor Ryan's diagram shows.

I will say that we have also quite recently adopted a method of drawing an accurate diagram of the wave of E. M. F. The method is due to Mr. Scott and Mr. Morris of our laboratory. I have not applied it yet, and have not seen it applied to the purpose of noting accurately the form of wave derived from our ordinary (Westinghouse) machines since we have been more especially engaged on new types and various experimental work. The method, however, would afford a very ready means of checking up this observed kink in the curve; and I shall take the trouble to make experiments as soon as possible to throw light upon that point. The method in question consists in mounting upon the armature shaft a wooden disc with a metallic contact at one point in the periphery, this point being connected with one terminal of a voltmeter, while the other terminal of the voltmeter is attached to one collector of the dynamo. A brush that is connected with the other collector touches the metallic point on the disc once in each revolution. By altering the position of the disc we can get a potential reading on the voltmeter proportional to the electromotive force developed by the machine at any given position of the armature; and moving it gradually through 180 degrees we have obtained surprisingly accurate results, the quantity of current through the voltmeter being large, and the time being very small. The cards which I have seen made out in the last week are very accurate, and show perhaps 40 points on a phase diagram. I regret that I have none of the cards here, as they might be interesting in connection with the points brought out.

I would like to add one observation, and it is with regard to the observed efficiency of the transformers. It is of course understood that the efficiency of a small transformer is necessarily much less than that of a large one. The conditions heretofore have been such as to compel the use of small tranformers, but the tendency, as we observe it, is very strongly towards the use of larger ones. This tendency will do away in great measure with the implied criticism upon the efficiency of the transformer system.

Dr. GEYER: I might say that three years ago, when the then existing methods of measuring the efficiency of such apparatus were very uncertain, we resorted to some heroic treatment of it. We stripped the transformer of this outer coil (which, I think, has not much to do with the efficiency) and the whole transformer was immersed in kerosene oil, and the transformed current was also used up in a jar of kerosene calorimeter; and then we found that as the load was increased the proportion of heat in the calorimeter to the total heat produced was less and less as the load was made greater and greater.

Mr. TESLA: Mr. Stillwell has alluded to a method of tracing the wave. I would like to ask the members if any of them have ever made an attempt to find out whether there is a difference when the laminated sheets of the transformer are loose or tight, and, if not, I wish some one in his idle hours would investigate that; because I have reason to believe that there is a difference when the sheets are tight and when they are loose. Of course it might be due to the imperfect contact of loose sheets, which would tend to diminish or increase the circulation of Foucault currents.

Some Peculiarities of Alternate Currents.

BY W. E. SUMPNER, D.SC.

Alternating currents are not by any means new, although it is only lately that they have become of great importance in engineering work. The dynamos first made yielded alternating currents because, as they needed no commutator, they were simpler to construct. They were not adopted, partly because continuous currents were easier to understand and to use, and partly because direct-current dynamos could be made self-exciting. Alternators came to be looked upon as antique types which had yielded place to the more perfect direct-current machines. However, the currents used outside the dynamo, although direct, were, of course, the result of rectifying, by means of a commutator, the alternating currents produced in the armature by its own revolutions. All dynamos, therefore, produce alternating currents in the first instance; and in the same way all motors, before they will work at all, must be fed with alternating currents, whether a commutator is introduced to produce these alternations or not. The action of all machines used for the production of currents depends on the properties of magnetic change discovered by Faraday. The currents induced depend on the rate at which the magnetism varies, and alter in direction as it decreases or diminishes. The magnetism cannot be always changing in the same direction, so that the currents induced must be alternating. Nearly all the useful appliances of magnetism result not so much from magnetism itself as from the alteration of it. This is the case, for instance, in telegraphy and telephony, in which we are always using varying or a ternate currents. If I pass an alternate current through one of the coils of this transformer we hear it singing. The current in the coil induces magnetism in the iron, and this changes in direction every time the current alternates. The magnetism acts on the windings of the coil, causing attractions which vary in amount with the strength of current, and it also causes in the iron itself stresses and strains which alter at every reversal of current. Vibrations are therefore set up which give rise to a note of a pitch corresponding with the frequency of the current. If due to any irregularities in driving or want of symmetry in the dynamo, the strength or frequency of the current is subject to variation; the note given out by the transformer will indicate this by altering its strength and pitch. The consequence is that the sound given out is very similar to the hum of the engine and dynamo. The transformer acts like a telephone, and indeed in principle a telephone is nothing more.

The first difficulty in connection with alternating currents is to settle how to measure them. They are continually varying, and therefore cannot be said to have any value in particular. If I pass the varying current produced by this commutator through an incandescent lamp, you notice that when I turn the handle slowly the lamp varies in brightness as the strength of the current changes. If, however, I turn the handle quickly so as to produce twenty or more per second, the lamp burns quite steadily. The strength of the direct current which would make the lamp burn equally well, is said to be the mean value of the alternating current used. This definition seems simple enough, but it defines the value of a current with reference to its heating effect only. It is soon realized that the importance of an alternating current depends chiefly on its magnetic influence, and not to any great extent on its heating effect. With steady currents the two are proportional, and each, therefore, is a measure of the other. Partly due to this cause and partly owing to the false notion that current carries energy along with it, we are liable to confuse the heating effect of a current which represents waste energy with the useful energy of the current which has no necessary connection with it, and in consequence some of the properties of alternating currents seem at first surprising. The efficiency and life of lamps seem to depend merely on the mean heating effect, for, as far as we know, they are the same for direct and alternating currents in spite of the fact that with the latter the maximum value of the current is far in excess of the mean value. With most of the practical applications of alternate currents, however, we have to bear in mind not only the strength of the currents, but also their frequency and magnetic surroundings. The currents and potentials are continually rising and falling in value. They are really waves and have all the properties of waves.

Now one of the chief peculiarities about waves is that they do not add together in the same way that numbers do. They add together like forces. We all know that if two forces, each of one pound, are acting on a body, the effect is not the same as that of two pounds, unless the two forces act in the same direction. According to the angle between the forces the equivalent to the two may vary from two pounds to nothing. If two men are pulling at the same rope in order to ring a church bell it is necessary for them to pull together, or one will tend to stop the bell while the other is trying to ring it. In the same way two waves flowing to the same point will add to each other's effect, if their rising and falling occur at the same time, but otherwise they will interfere and diminish each other's effect so that the resultant disturbance may be less than that which either would have caused separately. It does not, therefore, follow that two alternating currents following into the same wire will produce a current whose strength is the sum of the strengths of the two components, and, as Lord Rayleigh* has pointed out, if a current branches into two parts, by means of two parallel circuits, it may happen that each of two branch currents is greater than the original current. I have here the primary and secondary circuits of a Mordey transformer connected in parallel in such a way that if steady currents were flowing the coils would magnetize the iron in the same direction. In the main circuit and also in each of the branch circuits a Bernstein lamp is placed. When I close the circuit you notice one lamp is much brighter than the others, and the brightest lamp is in the branch circuit, not in the main. If I now disconnect one of the branch circuits the current diminishes to practically nothing, although the potential on the remaining coil actually increases. Shunting one coil with the other, therefore, not only increases the main current, but also that in the part shunted. These effects, of course, do not occur with steady currents. A somewhat similar experiment is due to Mr. Blakesley. His branch circuits consists, one of a resistance possessing self-induction, and the other of a condenser. By suitably choosing the capacity of the condenser, it is possible to increase the current through the self-induction branch, and make it exceed the current in the main circuit. Mr. Blakesley calls his arrangement a condenser transformer, and it seems to have important practical bearings. The following experiment is due to Mr. E. W. Smith,† of the Central Institution. It is analogous to Lord Rayleigh's: potentials are dealt with instead of currents. Here is a coil having a fairly large amount of self-induction, in series with an inductionless resistance. Here are two similar lamps of large resistance shunted, one to the inductive and the other to the non-inductive resistance. I pass the alternating current through the arrangement, and adjust the resistance till the lamps are equally bright. Each lamp now measures the difference of potential of the points to which it is shunted. I now remove the wire which connects the junction of the two lamps with the junction of the inductive and non-inductive portions. You notice that each lamp diminishes in brightness, showing that the whole potential difference is less than the sum of the two halves. By making the shunt connection again, each lamp brightens up, although Mr. Smith's experiments have shown, and theory confirms the fact, that the main current from the dynamo is diminished by so doing. By making the shunt connection, we necessarily diminish the resistance, although the potentials appear to increase and the main current to diminish, quite the opposite of what would occur with steady currents. I have extended this experiment by forming a Wheatstone bridge, two opposite arms of which consist of inductive resistances, the remaining arms being non-inductive. To each corner of the bridge I have attached a flexible lead coming to these lamps. The two wires attached to the corners of the bridge connected with the dynamo I have labeled red, and the remaining two, joining the parts of the bridge usually attached to the galvanometer, are labeled white. I connect the red wires to the terminals of the two lamps, the junction of which I connect successively with the wires, adjusting in each case the corresponding non-inductive resistance till the lamps are equally bright. Each time I make connection with the white wire the lamps brighten as before. From analogy with steady currents we should now expect the bridge to be balanced, since the potential difference between either red and either white wire is the same. This, however, is not at all the case, for if I join the white wires to the extremities of the two lamps, we notice they burn almost as brightly as when joined to the red wires connected directly with the dynamo. Theory indicates that if the impedance of the inductive arm were large compared with its resistance the potential between the white wires would be exactly equal to the potential between the red ones, and that in any case if the bridge is balanced in the way described there will be a difference in phase between the two potentials corresponding with a quarter of a period, so that one potential difference will reach its maximum when the other is zero. Now this is exactly the difference in phase required to drive a Tesla motor. I have here a small anchor ring of iron wound with coils in four quadrants. The coils in opposite quadrants are connected in series, so that a steady current flowing through either pair will cause a north and south pole in the adjacent quadrants. If non-alternating currents differing in phase by a quarter of a period are sent through the two coils, each pole will move from one quadrant to the next every quarter of a period, so that the polarity will revolve round the ring with the same frequency as that of the alternating current.

There is an iron disc free to revolve about the axis of the ring, and when I connect the red wires with one pair of coils and the white wires with the other, you see the disc spins round at a great velocity, and thus forms a Tesla motor. There is, however, this peculiarity about it, that only one alternating current is used. The disadvantage of a Tesla motor is that it requires two alternating currents, fixed in phase with reference to each other, so that it is necessary to have a special dynamo to produce the currents, and also to have at least three leads instead of two. Here, however, is a method of making any alternate current work a Tesla motor. Mr. Blakesley‡ has, I find, already suggested his condenser transformer for the same purpose. The method I have suggested is not economical, but it can be improved by having the arms of the bridge of high resistance or impedance, and having two opposite quadrants of the Tesla field magnets wound with many turns of fine wire instead of a few turns of thick wire. Moreover, if condensers of suitable capacity are substituted for the non-inductive arms of the bridge, the waste will be smaller, and the amplitude of the potential between the white wires will actually be greater than that between the red ones attached to the dynamo. At all events, there seems to be fair ground for supposing that some such arrangement can be found, by means of which a Tesla motor can be economically worked off any alternating current.

Striking effects of interference are obtained by putting a coil, whose impedance is large compared with its resistance, in series with a condenser of suitable capacity. If an alternating current is passed through such an arrangement, and measurements of potential are made with a quadrant electrometer used idiostatically, the potential at the terminals of the coil or condenser are each found to far exceed the potential at the ends of the combination. Theory indicates that under the most favorable conditions, the two former are equal to each other, and the ratio of either to the latter is then approximately equal to the ratio of the impedance of the coil to its resistance when this ratio is fairly large. Thus with the secondary of an induction coil having a resistance of 6,000 ohms, and coefficient of self-induction 50 quadrants or secohms, and with a condenser of 0.05 microfarad capacity, calculation shows that the most favorable frequency of current to employ would be 98 periods per second, and that the potentials on the coil and condenser would then be each about five times the potential on the two in series. In the confirmation of this by actual experiment, I have had the advantage of the assistance of Messrs. Monckton, Simon and Taylor, of the Central Institution. The field magnets of an alternator were excited with suitable currents, so as to produce at varying speeds of the dynamo an alternating potential of about 30 volts. In the annexed table the results obtained are recorded. The number of periods per second corresponding with the speed of the dynamo is indicated in the first column. The second column gives the ratio of the potential on the induction coil to that of the dynamo, and, of course, is equal to the square root of the ratio of the corresponding deflections. The third column gives the ratio of the potential on the condenser to that of the dynamo. The last column gives the sum of these two ratios, which, but for interference, would always be unity.

Periods per second.	Potential on coil.	Potential on condenser.	Sum of potentials.
73	1.00	1.93	2.93
82.5	1.84	2.64	4.48
102	4.38	4.14	8.52
116	3.28	2.49	5 77
120	2.91	2.06	4.97

From these numbers it is evident that the potentials on the coil and the condenser will be equal when the frequency is less than 102 periods per second, and that the sum of the two potentials will be greater than 8.52 times the potential of the dynamo. When it is considered that the self induction of the coil, which had an iron core, was measured not with rapidly alternating currents, but with a single impulsive change of current, the agreement between the theory and experiment is quite satisfactory. But although theory so perfectly accounts for the effects, it is nevertheless surprising that a difference of potential can be divided into two parts, each of which is so much greater than itself. Of course, if 20 accumulators are connected up in series with 19 others, and in opposition, the potential on the whole is two volts, while those of the parts are 40 and 38 respectively, and this tends to prove what is practically true, that the alternating potentials are in opposite phase; but the peculiarity with alternating currents is that the potential of the two parts may be exactly equal, while that of the whole is neither the sum of the two nor the zero difference.

What is really happening in these cases of interference is illustrated by an experiment on pulsations which I am able to perform by means of an ingeniously contrived commutator kindly lent me by Mr. H. B. Bourne. Alternate bars of the commutator are connected together, and to the two ends of a battery of cells. There are two brushes, one fixed and the other movable, so that as the commutator revolves, one brush may be made to move over the bars more rapidly than the other. Each of these brushes is connected with the middle of the battery through the primary of a transformer. As the commutator revolves, an alternating current comes off from each brush. The period will be the same if the brushes are both fixed, and the phase may be altered by moving one brush with reference to the other. If one brush revolves slowly, the two alternating currrents are of a slightly different period. The two secondaries of the transformers are connected in series with themselves and with an incandescent lamp. The brightness of the lamp measures the sum of the two currents induced on the secondaries by the alternating currents in the primaries. If the currents coincide in phase the lamp burns brightly, while if the phase of the current is opposite, as I can arrange by suitably fixing the movable brush, the lamp is extinguished. If I now revolve the movable brush slowly the phase of the currents is continually altering, and you see the lamp slowly pulsating in brightness. Although the two alternating currents induced in the secondaries are always of the same strength, yet their sum varies from zero to double the value of each, according to the phase of one with respect to the other.

After all, however, the most extraordinary property of alternating currents is that which has been longest known, viz., their tendency to transfer themselves from one circuit to another with which they have apparently no connection. The appearance of these induced currents is accompanied not by decrease, but by an increase of the primary. The primary and secondary increase together. The explanation is that the currents are in nearly opposite phase, and one current is neutralizing the magnetizing effect of the other. The magnetism caused by alternating currents always tends to a minimum, and the currents have to arrange themselves so that their joint magnetizing effect may be as small as possible. This tendency is very marked at high speeds, and the compensation is almost perfect. The little magnetism remaining is, however, very important, because of its extremely rapid rate of variation. The induced electromotive force depends on this rate of variation, and not on the maximum amount of magnetism. Thus, in transformers there is a strong tendency for the primary and secondary currents to be in opposite phase. [This is the explanation of a simple but important experiment due to Mr. Mordey, and the fact was proved by a large number of experiments of Messrs. C. G. Lamb and E. W. Smith, made at the college some time ago."] The strengths of the currents in the coils also arrange themselves to be nearly in inverse proportion to the number of turns, for this is the condition, that the magnetizing effects should be equal. There is also a tendency for the magnetism to alter itself in the simplest way possible, and this is according to the law of sines. The secondary currents, therefore, tend to follow the law of sines, because they exactly follow the variations of magnetism. The primary current will also follow the law of sines if the magnetism is proportional to the current; but if saturation is approached calculations I have made from experimental data show that the primary current may depart very much from a simple sine wave, as will also be the case if the electromotive force acting on the primary is itself irregular. The tendency of magnetic change to a minimum is exemplified in the action of choking coils and in the heating of iron cores. If an opposite current can be induced in neighboring circuits or bodies so as to cancel the magnetizing effect, the primary current is allowed to flow, but otherwise the reluctance of the magnetism to change suddenly will prevent the current rising to any magnitude. The same tendency occurs within the wire itself, for the adjacent portions of the current tend to flow in opposite direction. The tendency to reverse currents is strongest in the centre of the wire, and consequently the current density is less there than near the surface. The resistance of the conductor is increased by this, and the alteration is very important when the wires are thick and the alternations of the current are very frequent, as, for instance, in the thick wire circuit of electric welders. Thick leads are, therefore, not well suited to alternating currents; but, on the other hand, they are rarely necessary, for, by means of transformers, large amounts of energy can be efficiently transmitted immense distances by means of inexpensive thin wires.

It is not, however, only in engineering practice that alternate currents have become of great importance. Within the last year or so the theory of electricity has been advanced tremendously by the study of alternating currents. We have seen that with rapid alternations the currents are determined chiefly by the magnetic changes which are going on, and that they arrange themselves as far as possible to neutralize each other's magnetic effect without much apparent regard to the electromotive force acting on the resistances in circuit. This tends to show that the most important part of an electric current is not in the wire itself but in the wire outside. It has been by considering the changes going on in the medium outside the wire, that Hertz has been able to experimentally prove the existence of effects which have hitherto only had a mathematical basis. If a current is reversed in direction the lines of force surrounding it are also reversed. Maxwell's theory, however, states that they do not reverse instantly. The lines of force near the wire reverse before the others. There is a certain velocity at which the reversal of the lines travels, and this velocity, according to theory, should be about the same as the velocity of light. That this is actually the case is one of the things which Hertz has lately shown. In order to do so, he had made use of rapidly alternating currents. He has also employed a detector whose great delicacy is due to the principle of resonance, which may be illustrated by an experiment of Prof. Ayrton's,† which I have arranged. An alternating current is passing along this stretched wire. When I hold a magnet near, the wire is pulled aside, due to the mutual action of the current and the magnet's lines of force. Every time the current reverses the direction of the pull on the wire reverses, so that the wire is put into a state of vibration. The loudness of the sound, however, depends on the length of the stretched portion of the wire. There is one length that will give the best effect, and this happens when the wire is tuned to give out a note of the same pitch as that corresponding with the frequency of the alternating current. The current in any case forces the wire to give out a particular note, but if the wire naturally gives out that note, the sound produced is much greater. The interference of potentials occurring when an induction coil is placed in series with a condenser, is another instance of resonance, for the condition that the potential on the coil should be greatest compared with the whole potential acting on coil and condenser, can also be shown to be the condition that the natural period of oscillatory discharge of the condenser into the coil coincides with the period of alternating current. It has been by using this principle of resonance that Hertz has been able to detect, in the medium outside the wire, cases of interference with magnetic reversals, exactly similar to those I have shown you with alternating currents and potentials. His work has opened up an endless field of discovery, and these results have been brought about by making use of the peculiarities of alternating currents.

First Annual Dinner of the Wright Electric Engineering Company.

On the evening of Jan. 1, at the American House, in Boston, was held the first annual dinner of the Wright Electric Engineering Company, which was attended by the complete office staff and various foremen, 25 in number, and a few friends of the company. The menu was unique in form, and thoroughly calculated to gratify the appetites of the gentlemen present, being interlarded with numerous electrical terms. On the front page was represented a substantial line pole with cross arms and pins, and at its base a reel of line wire, with a few of the implements of electric construction, was well represented. After dinner telegrams of regret were read from various gentlemen, including such well-known names as David D. Dunn, O. K. Stewart, John M. Crane, and W. A. Stiles. Mr. Ridlon, who occupied as president of the company the head of the table, with Mr. Alex. P. Wright as *vis a vis*, then made an interesting address of welcome to all present, and drew attention to the wonderful success which had been achieved by the Wright Electrical Engineering Company. Only a year ago, one man, Mr. Alex. P. Wright, represented the company, and now a glance around the table was sufficient to show what vast strides they had made in that time. Success was achieved by the determined energy of their

* Presidential Address to the City and Guilds Old Students' Association, Nov. 19, 1889.

* See *Phil. Mag.*, May, 1886. p. 378, and also December, 1886, p. 495.
† *The Electrician*, June 14, 1889, p. 162.
‡ See the discussion on Mr. Kapp's Paper on "Alternate-Current Machinery," *Proc.* Inst. Civil Engineers, February, 1889.

* See discussion on Mr. Kapp's paper on "Alternate Current Transformer," *Jour.* Soc. Tel. Eng., Feb. 23, 1888. Also see a note of Profs. Ayrton and Perry on "The Lag in Transformers," THE ELECTRICAL WORLD, April 14, 1888.
† THE ELECTRICAL WORLD, July 27, 1889.

managing director, coupled with the good feeling and the hearty co-operation of the employés. Mr. Ridlon was glad to see them all, and have an opportunity of meeting them one and all around the festive board in an informal manner.

Mr. Wright then addressed a few remarks, giving a short history of the progress of the company. Originally he held the various positions of office boy, engineer, bookkeeper, etc., but now 25 heads of departments were necessary to carry on the business. He hoped next year to see 50 per cent. or 100 per cent. more at the annual dinner, and meant by close application to make the Wright Electric Engineering Company the biggest construction company in the United States.

Speeches were also made by Messrs. John Post, Jr., F. E. Pettingell, C. H. Herrick, W. E. Stone, S. Horton, W. Pettingell, T. Gould, Jr., Dr. Austen, A. C. Shaw, Col. Ransom and Mr. Cole.

Mr. T. McCoubray, one of the guests of the evening, and well known to the electrical fraternity as an earnest and loyal worker in the electric field, then favored the company with a few neatly turned sentences, abounding in condensed wisdom and overrunning with a spirit of humor. He took exception to the remark of one gentleman that electricity would always remain a "mystery," but rather maintained that it would ultimately end in a "mastery."

Mr. L. S. Dumoulin, of the West End road, paid some flattering compliments to the Wright Company, after which Father McGlynn duly pronounced the benediction with great solemnity.

The First Edison Station in New York City Burned.

A fire broke out, on the morning of January 2, in the old Edison station in Pearl street, and before it could be got under control it had practically wiped the plant out of existence, doing damage to the extent of about $100,000. The plant, which was carrying a full load of about 18,000 lights, will be restored as quickly as possible, and new dynamos and engines will be installed and running within a few days. In the meantime, the annex station at Liberty street is carrying a large portion of the load.

The station thus destroyed is quite historical, being the first incandesdent central station built in this country. It is supposed by many, and has been stated in the newspapers, that it was the first in the world. This is hardly correct, however, as the first incandescent central station actually to go into operation was that started in London by Messrs. E. H. Johnson and W. J. Hammer, on the Holborn Viaduct, on Jan. 12, 1882. That station, which was intended to serve only a temporary purpose, was soon loaded up with 3,000 lights, and was equipped not only with the old Edison "Jumbo" machines, like those in Pearl street, but with the first Edison meters, etc. The circuits were underground, and with them the first street lighting with incandescent lamps was also done. The passing of the repressive legislation against electric lighting in England checked the enterprise, and forbade the construction of the proposed large station.

A Standard Wiring Table.

At the December meeting of the Council of the American Institute of Electrical Engineers, a committee of members was appointed to formulate and submit for approval a standard wiring table for lighting and power purposes. The committee consists of F. B. Crocker, Chairman; Thomas P. Conant, Dr. Louis Duncan, Prof. W. E. Geyer, A. E. Kennelly, Geo. B. Prescott, Jr., Prof. E. P. Roberts, William Stanley, Jr., Dr. Schuyler S. Wheeler.

The first meeting of this committee will be held at the rooms of the Institute, 125 Temple Court, on Friday, Jan. 10, 1890. It is not intended to make any radical departure from the best practice of to-day, but rather to establish a table which shall be generally recognized and used as a standard. Any suggestions from persons interested in this matter will be welcomed. Address communications to F. B. Crocker, Columbia College, New York City.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, Jan. 4, 1890.

Mr. C. E. Bleyer, New York manager of the Smith Feed Water Heater Company, *Times* Building, started for Europe Jan. 1, to be gone nearly two months on business of the company.

The Litofuge Manufacturing Company, 53 Cedar street, have issued a neat little pocketbook which is as perfect a thing in its way as their well-known boiler compound. It has a renewable memorandum pad.

The Crosby Electric Company, *Judge* building, are manufacturing a full line of various sizes of Crosby dry batteries, all of which ring a six-inch iron skeleton frame bell very satisfactorily. They are also producing other specialties.

The Storey Electric Mining Hoist, of the Sprague Company, illustrated in The Electrical World of Jan. 4, is set up in the Edison station in Brooklyn, and is in operation there exhibiting its power in hoisting 1,300 pounds of iron with ease. Mr. J. H. Vail, of the Sprague Company, is pushing the mining department of the business, and has it in such excellent working shape now that the heaviest orders can be filled immediately.

The Backstrom Electric Company have started in a new location, 154-156 West Twenty-seventh street, where Mr. Backstrom has two floors devoted to the manufacture of his incandescent lamps and fittings, using Continental dynamos for testing. His lamp, which has been illustrated in your columns, has its carbon filament supported by a thin central rod, so as to resist shocks and vibrations. Mr. Backstrom also makes a neat ceiling cutout.

Station Engines for New York.—Within two hours of the burning of the Edison station in Pearl street Mr. E. T. Copeland, 30 Cortlandt street, had orders at his works for 500 h. p. New York Safety electric light high speed automatic engines, to be in this city Jan. 3, to replace those burned. The annex plant of the Edison Company, in Liberty street, where New York Safety engines are in use, is taxed to its utmost to meet the extra pressure for lights in the burned district.

H. E. & C. Baxter, of Brooklyn, are as busy as can be in the production of their standard annunciators, bells, push buttons, etc. They put in, some time ago, an Arnoux-Hochhausen electroplating dynamo, and they speak in high terms of it. They are doing a large plating business outside their own work. Their woodworking department is kept busy on annunciator and burglar alarm cases, etc. Their fine metal letter box and push button combination sets are meeting a well-merited demand.

Dyer & Seely.—I note that Mr. Charles M. Catlin has just resigned from the examining corps of the Patent Office, and has associated himself with Dyer & Seely, of 40 Wall street. Mr. Catlin entered the Patent Office in March, 1882, and, with the exception of the first six months of his employment, has been constantly engaged upon work in the electrical division, having during that time had occasion to examine into all branches of the subject of applied electricity. At the time of resigning Mr. Catlin was the first assistant examiner in electricity, Division A, which position he had held since 1886.

The Safety Insulated Wire and Cable Company, 234 West Twenty-ninth street, Mr. Leonard F. Requa, general manager, have introduced within the year thousands of feet of their safety insulated electric light wires and cables covered with their special compound insulation without joints, into the conduits of this city, and it is said to give great satisfaction. Mr. Requa, the inventor of this system, has devoted his time to the improvement of the insulation of wires and cables for a number of years, and seems to have met with success in his latest production, which shows no joints in the parallel sections of covering. He will furnish a reel of any size and length of wire or cable without leaving a joint in it. This company have fitted up nice offices at the above address, and are increasing their manufacturing facilities as fast as possible to meet the demand for wires and cables of all sizes and for all purposes. I have seen some of their electric light wires, intended for the conduits of this city, covered with lead, and the insulation covered the wire evenly. No joints were visible or could be felt, and the insulation was hard and tough, yet very flexible.

Holmes, Booth & Haydens, of Park Place, this city, report that their patent K. K. insulated copper wire is used on the electric roads built and in process of construction at the following places: Davenport, Ia., Central Railway Company; Lafayette, Ind., Electric Street Railway Company and extension; Cleveland, Ohio, East Cleveland Railroad Company; Stillwater, Minn., Electric Railway Company; Tacoma, Wash., Railway and Motor Company and extensions; West Bay City, Mich., City Railway; Sterling, Ill., Union Railway Company; Cincinnati, O., Inclined Plane Railroad; Eau Claire, Wis., Street Railway Company; Dubuque, Ia., Key City Electric Street Railway Company; Buffalo, N. Y., Street Railway Company and Extension No. 1; Dayton, O., Soldiers' Home Railway; Moline, Ill., Central Railway Company; Piqua, O., Street Railway Company; Sioux City, Ia., Street Railway; Chicago, Ill., Cicero & Proviso Street Railway; Scranton, Pa., Peoples' Street Railway Company; Denver, Col., South Denver Tramway Company; St. Joseph, Mo., Peoples' Street Railway Company; Salt Lake City, Utah, Railway Company; Wichita, Kan., Wichita & Suburban Railway Company.

W. T. H.

NEW ENGLAND NOTES.

Branch Office of The Electrical World,
Room 8, Cook Building, cor. Franklin and Congress Sts.
Boston, Jan. 4, 1890.

Mr. F. N. Sanderson, manager of the Amherst Gas Company, Amherst, Mass., which recently put in a Westinghouse incandescent plant, was in Boston this week.

Revere, Mass.—The selectmen have ordered the managers of the Revere & Boston Electric Railroad to resume the operation of its road at once and comply with the conditions of its location.

The Standard Electric Company of Vermont report having sold a 300-light plant to the Sims & Dudley Paper Company, Holyoke, Mass., and a 50-light plant to H. B. Cutter, 1018 Chestnut street, Philadelphia.

The New England Weston Company have just completed a large addition to the electric lighting plant of the Equitable Building, Boston. The addition consists of a number of extra lamps on each floor of the building, and the plant is now one of the most complete isolated plants in the city.

Speed of Electric Cars in Boston.—At a meeting of the Board of Alderman held this week an amendment to the ordinance regulating the rate of speed for street cars and horse travel, was passed, allowing the electric cars to go faster than six miles an hour south of Dover and Berkeley streets.

The New England Wiring and Construction Company have secured the contract to wire the temporary power station of the West End Street Railway Company, on Harrison avenue. The wires will be connected to the 500-volt power circuit and 180 Edison lamps will be used, five in series.

South Framingham, Mass.—The South Framingham Electric Light Company have recently made an addition to their plant of a 650-light incandescent dynamo, and have now in order a 1,300-light incandescent machine. During the month of December this company has added some 500 lamps to their plant.

Boston Electric Club.—The first inaugural dinner of the club for the year 1890 will be held at Young's Hotel on the evening of Jan. 6, at which the newly appointed officers will be formally initiated. The business meeting of the club will be held immediately previous to the dinner in the hotel.

Somerville, Mass.—At a meeting of the Somerville City Council held this week orders were adopted allowing the New England Telephone and Telegraph Company to erect poles and wires on Highland avenue, Belmont street, Somerville avenue, Porter, Elm, Prospect, Webster avenue, Bow, Walnut and Medford streets.

Manchester, N. H.—The annual meeting of the Northern Telegraph Company was held on Dec 31. Ex-Gov. Frederick Smyth, Col. John B. Clarke and William F. Head were chosen directors, and Charles H. Bartlett, clerk. A 4 per cent. annual dividend was declared. The line is leased to the Western Union.

The Edison Electric Illuminating Company, of Boston, have just completed the work of installing the electric light in the Boston Theatre. There are 550 lights in all. The fixtures were designed by Mr. B. Wm. Allen. The theatre is now one of the most brilliantly lighted in the city, and the switchboard, though plain, is substantial, and specially designed to facilitate the quick manipulating of the lights.

The American Electrical Works, Providence, R. I., have issued a very effective calendar this year. At the top is a photogravure reproduction of one of the clambake groups, combining all ages and all types of masculine beauty. The copyrighted pad is full of historical data, compiled by Mr. T. D. Lockwood, with his usual care and accuracy. President Phillips has everybody's thanks for this useful piece of office stationery.

The Wright Electric Engineering Company held their first annual dinner at the American House on the evening of January first, which was attended by all the office staff and foremen of the different departments. A most enjoyable evening was spent, and mutual congratulations upon the remarkable growth and success of the company were indulged in. Mr. Alex. Wright received many congratulations on his hard won success.

Interior Electrical Conduits.—The new offices and apartment house of Mr. Francis Goodwin, at Hartford, Conn., will be fitted with the complete system of interior electric conduits. The building will be wired for about 800 lights, and will contain about 30,000 feet of conduit. Messrs. R. T. Oaks & Co., Holyoke, Mass., contractors for electric lighting, have adopted the interior electrical conduit system, and will use it in all their house work hereafter.

Lynn, Mass.—For some time the office staff of the Thomson-Houston Electric Company have had to endure very limited quarters in their factory at Lynn, and they have now commenced work on a new office building in Centre street. The new office building, which will also contain a drafting room and very complete testing room, will be three stories above the basement and will contain 25,000 feet of floor space. Three fire proof vaults will be constructed, one for each story.

The Thomson-Houston Electric Company have reason to congratulate themselves over Judge Gresham's recent decision in the Circuit Court at Indianapolis, sustaining the patent on double-carbon arc lamps owned by the Brush Electric Co. The Thomson-Houston Company now virtually own these patents, as they control the majority of the stock of the Brush Company, and it is believed it will be impossible for any form of double-carbon arc lamps to be used without infringing on these patents.

The Thomson-Houston Company reports the following sales of incandescent apparatus to central stations: Sioux Falls, South Dakota, 50; Tuscumbia, Ala., 100; Mays Landing, N. Y., 400; Portland, Me., 800; St. John, Mich, 500; Boston, Mass., 500; Adams, Mass., 500; Middlesboro, Ky., 300; Seymour, Conn., 500; Langhorn, Pa., 500; Plymouth, Mass., 500; East Greenwich, R. I. 850; Oswego, N. Y., 1,300; Hyde Park, Mass., 1,300; Andover, Mass, 650; Winchester, Md., 650; Somerset, Ky., 650; Watertown, N. Y., 650; Catskill, N. Y., 650; Rochester, N. Y., 650; Huntington, Pa., 650.

Work for the Coming Legislature.—One of the first petitions which will come before the State Legislature will be one for authority to introduce a system of electric lighting in Danvers to be controlled by the town. Last year the town of Danvers petitioned for authority, but the bitter opposition of the companies, which saw in the matter an entering wedge which would lead to the overthrow of their own system of ownership, led to the defeat of the bill. This year the town will make another contest for the same privileges, and it is reported that the town of Wellesley will make a push in the same direction.

The Thomson-Houston Electric Company, reports the following sales of arc apparatus to central stations:

Lowell, Mass., 25; Rochester, Md., 50; St. John, Mich., 30; Camden, Ark., 30; City of Chicago, Ill., 210; Chicago, Ill., 100; Litchfield, Ill., 50; Fairhaven, Washington, 30; Chattanooga, Tenn., 100; Toledo, O., 50; W. Superior, Wis., 50; Cincinnati, O., 200; Macon, Ga., 100; Pottstown, Pa., 50; Spokane Falls, Wash., 100; Huntington, Pa., 50; Bedford, Md., 50; Long Branch, N. Y., 100; Wilkesbarre, Pa., 50; Austin, Minn., 50; Weymouth, Mass., 60; New Haven, Conn., 50; Missoula, Mont., 50; Cedelia, Mont., 100.

The Electric Piano Company continue to have a large success with their novel piano, which is a source of wonder and interest to large numbers who call to see it. A large business has already been done, and Mr. Bailey informs me that they are already busy supplying orders for their patent electric attachment, which can readily be put on to any piano. Their most recent production is a handsome cabinet and music stand, furnished with an electric attachment, to be used in connection with the self-playing æolian organs, by which the electric current is made to produce music from these beautiful instruments The music stand is intended to be placed alongside the organ, and, being constructed in perfect harmony with these instruments, forms an ornament to any room.

Jarvis Engineering Company.—An interesting and unsolicited testimonial to the efficiency and skill of this company, and the quality of the goods they represent, was recently received by them in the shape of a letter from Mayor Bragg, of Bangor, Me., regarding the boilers and engines which they furnished to the municipal electric light plant. The engine, a 150 h. p. Armington & Sims, installed along with Jarvis boilers, for the purpose of forming auxiliary power, in case of anchor ice retarding the turbines, had never been "turned over." There had never been any fire in the boilers, and yet, when a sudden emergency arose, the fires were kindled, steam generated and the full load put on the engine, which ran throughout the night without a single hitch, much to the satisfaction of the Mayor and all concerned.

Walworth Manufacturing Company have just shipped some 2,000 poles and brackets for the Cohoes division of the Troy & Lansingburg Railway. Col. L. R. Greene, of this company, has recently received a patent for a welded pole, which he claims will soon come into large demand. The Walworth Company's poles are generally in three parts, jointed together, and this patent covers broadly the welding, by any means, electrical or otherwise, of these parts together, so as to form a uniformly tapered pole. In these advanced times, when the subject of overhead construction is receiving so much attention at the hands of city governments, as well as the electric companies, there is little doubt but some uniform, strong, and, at the same time, neat pole will be adopted, and the Walworth Company are well prepared to supply the increasing demand.

Electrical Execution of a Dog.—In Boston we do not kill men by electric currents in the wholesale way in which they are killed in New York, but recently a beautiful dog belonging to a newsdealer of this city got roasted to death by coming in contact with the framework of an entrance on Washington street which had evidently become charged with the electric current from an arc light wire. Such accidents are scarce in Boston, and the electric men of this city are proud of it, but even the sacrifice of this dog should act as a warning, and suggest constant supervision of all wires, so that it may become a matter of practical impossibility for the current to come into contact with an iron framing. Good work, good materials and intelligent supervision ought to prevent effectually any possible recurrence of such an accident, and stop forever the mouths of the croakers who eternally speak of the dangers of the "deadly electric current."

Bids for Electric Lights in Boston.—Sealed proposals were opened yesterday at the Mayor's office for furnishing electric lights for public street lighting for a period of one, three or five years.

The bids were as follows:

SUBURBAN LIGHT AND POWER COMPANY.

	Cents.
For Roxbury, for one year, per lamp per night	38 99-100
For three years	38 99-100
For five years	37 99 100
For city proper, South Boston, West Roxbury and Dorchester for five years	39 74-100

BROOKLINE GAS COMPANY.

For Brighton, for five years	40

WALWORTH LIGHT AND POWER COMPANY.

For city proper, East Boston, South Boston, Charlestown, Roxbury, West Roxbury, Brighton and Dorchester, for five years	40

These companies agree to run electric wires to all electric lamps that may hereafter be located in the several districts for which contracts are awarded. The call for bids stated that none would be considered at a rate exceeding 40 cents per night for what is termed a 2,000 c. p. light. Letters were received from the Charlestown Gas Company and the Boston Electric Light Company. The former states that it is ready to supply electric lighting in Charlestown after its present contract with the city ends on Jan. 7 next—but not on the terms proposed by the city. The Boston company objects to the maximum price of 40 cents a lamp, and says that it

cannot supply light at such a price and do justice to the stockholders and give good service to the city. The price now paid by the city to the Boston Electric Light Company is 65 cents a lamp, which the Mayor objects to as being excessive. He claimed 40 cents was as much as the city should pay.

The Thomson-Houston Electric Company reports the following sales of apparatus for isolated plants: Arc Lights—Allentown Rolling Mill, Allentown, Pa., 18; L. F. Bartlett, E. Saginaw, Mich., 18; Pioneer Mining and Manufacturing Company, Thomas, Ala., 37; Merrimac Manufacturing Company, Lowell, Mass., 45; G. F. Blake Manufacturing Company, E. Cambridge, Mass., 30. Incandescent Lights—E. A. Gyde, E. Saginaw, Mich., 35; National Transit Company, Kane, Pa., 100; National Transit Company, Parker Landing, 100; Water-Works B uilding, Detroit, Mich., 100; St. Clair Hotel, Cincinnati, O., 100; Louisville Chair Company, Louisville, Ky., 200; J. O. Shoup & Co., Dayton, O., 1,600; Norfolk Woolen Company, Norfolk, Mass., 50; Wadsworth Howland & Co., Malden, Mass., 50; J. W. Ayer, Brewer Village, Me., 50; Allentown Rolling Mill, Allentown, Pa., 200; White Cycle Company, Westboro, Mass., 100; Midgely Wire Belt Company, Beaver Falls, Pa., 100; Locke Bros., Salem, Mass., 200; Woodrough & McFarlan, Cincinnati, O., 200; H. A. Marston, So. Framingham, Mass., 200; Eastern Manufacturing Company, Brewer, Me., 200.

Lowell, Mass.—After many hearings and long months of waiting the Board of Aldermen has granted permission to the Lowell & Dracut and Lowell street railway companies to erect poles, string wires and use the single trolley system or the storage battery system, or both, for propelling cars from the junction of Bridge, East Merrimac and Prescott streets to the various points in Belvidere. This is an amendment to the original petition presented by the companies to the board some three months ago asking for the right to use electricity, the single trolley system, on both lines throughout the city. The order, as passed, states that the road must be constructed to the satisfaction of the board; that the trolley wires used shall, wherever they are crossed by an overhead wire owned by the city, said company, or any corporation or person, and wherever the said board may from time to time order, be suitably protected by guard wires, and that all feed wires shall be placed under ground whenever said board shall order, and when grounded they shall be insulated in a manner satisfactory to such board. It further provides that the officers and members of the fire department may, in the event of a fire and wherever in connection therewith they deem it proper, cut the wires of said trolley system, and if so cut they shall be repaired at the expense of said company. In case of fire the company shall, on the request of any of the engineers of said department, discontinue any and all currents of electricity over its wires. It lastly calls upon the said companies to file with the city a bond for $10,000 to fulfill its contract with the city. This has been one of the most bitterly contested franchises in the New England States, and the result has been looked forward to with great interest. The telephone companies will now be forced to admit that the electric railway has come to stay, and that it is destined to be one of the largest industries of the future. It is useless to contest these privileges, for as one of the experts testified at one of the sittings, there is no company which "owns the earth." It is satisfactory, nevertheless, to note that the franchise includes the storage battery system, so that the railway company can have every opportunity of using the various systems and finding out by their own experience which is best and most suitable for their purpose. Electric railway business is still very young, and not even the most sanguine supporters of electric cars will deny that it is still capable of vast improvement. Give it a chance first for practical success, and the æsthetic can be very easily added thereafter.

A. C. S.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
31 CITY TRUST BUILDING. PHILADELPHIA, Jan. 4, 1890.

Appropriate Present.—Manager H. A. Cleverly, of the Cleverly Electrical Works, of this city, on Saturday last presented a turkey to each of his employés.

Mr. Harry Clay, Jr., the Pennsylvania agent for the Thomson Houston motor, has removed his Philadelphia headquarters from No. 26 North Seventh street to Nos. 1216 and 1218 Filbert street.

Electric Construction.—M. R. Muckle, Jr., & Co,, who have offices at No. 608 Chestnut street, are extensively engaged in wiring and equipping isolated electric light plants in this and neighboring States.

Electric Railway at Wilmington.—The directors of the Wilmington, Del., City Railway Company, at a meeting on Dec. 28, decided to co-operate with the Wilmington Inter-State Baseball Club by running a branch of the electric street railway direct to and from the new baseball park.

Connecticut Motor Agency.—Vallee Bros. & Co., of this city, have been appointed agents for the Connecticut Motor Company for the States of Pennsylvania, Maryland and Delaware This firm carry a full line of electrical supplies and engage in wiring and construction work. Their office and salesroom are at No. 17 North Sixth street.

The "Greene" Engine.—The Pennsylvania Iron Works Company, on South Fifteenth street, has been enjoying of late an active business in connection with electric light enterprises in this State and elsewhere throughout the country. The Greene automatic cut-off engine, manufactured by this company, has a widespread and firmly established reputation for compactness in form and durability in service.

Henry B. Cutter, electrical engineer and contractor, 1018 Chestnut street, Philadelphia, has established for himself an enviable reputation in this section for a high grade of electrical work. Mr. Cutter is agent for this State of the Kinsman multiple circuit arc lamp. Considerable interest has been awakened among those in this city who have seen the Kinsman lamp by reason of the low voltage required to operate it.

Arc-Light Globes or incandescent shades, in any shape or size, can be had to order from the following prominent glass manufacturers in this city, viz.: James J. Murray & Co., Trenton avenue, Culvert and Waterloo streets; Standard Flint Glass Works, No. 1126 Charlotte street; Franklin Flint Glass Works, corner Howard and Oxford streets; Messrs. Rohrbacker & Harmann, corner Salmon street and Lehigh avenue; and Messrs. Gill & Co., corner York and Thompson streets.

Tatham & Brothers, Nos. 224 and 226 South Fifth street, Philadelphia, are widely known manufacturers of lead-covered cables for electric lighting and telephone service. This house furnished the lead incased arc-light cables which were put into the conduits on Front street two years ago, and recent investigation showed that these cables were still giving thorough satisfaction. The attention of the Edison people having been directed to these cables, a large sample order has resulted for a similar cable, from the Philadelphia Edison Company.

Mr. Robert H. Engle, who was absent from this city during the past summer, has returned to hi home recuperated in strength. His friends and business acquaintances will find Mr. Engle again in his old position, *i. e.*, the electrician in charge of the cable and conduit department of the lead manufacturing house of Tatham & Brothers, Nos. 224 and 226 South Fifth street. While Mr. Engle was recreating in the Northeast, he passed a few weeks of the time in Montreal; and before leaving that city he established there the first Edison-Sprague power station in Canada. The enterprise has since led to the installation of numerous power plants in the city named; and recent advices set forth that the station alluded to and its many tributaries have been successful in every respect.

The Phœnix Iron Works, of Meadville, Pa., are very busy in all departments. They have done a larger business this year than ever before, and the prospects are that the business of next year will exceed this one. They have an order from the Sea Shore Electric Railway Company, at Asbury Park, N. J., for 150 h. p. engine and boilers, making a total of 400 h. p., and from the McGavock and Mt. Vernon Horse Railroad Company, Nashville, Tenn., for 400 h. p. engines and boilers, making a total of 600 h. p. in this plant. Both of these are second orders and for enlargement of the plants. Some of the largest orders are a 325 h. p. plant for Jersey City; 200 h. p. plant for Union Depot, Cincinnati; 100 h. p. plant for Burlington, Ia.; 100 h. p. plant for Jeffersonville, Ind.; 100 h. p. plant for Seattle, Wash.; 200 h. p. plant for Middlesborough, Ky.; 50 h. p. plant for Cape Girardeau, Mo.; 100 h. p. plant for Van Wert, O.; 250 h. p. plant for Piqua, O., and 150 h. p. plant (compound condensing) West Troy, N. Y.; besides orders for single engines and very large boiler orders,

Partrick & Carter, of this city, are installing an incandescent light plant on their premises, Nos. 112, 114, and 116 South Second street, and will illuminate their extensive factory throughout—as well as their offices and show-rooms—with the 16 c. p. incandescent lights. This old house (established 1867) is continually springing on the public some novelty or ingenious improvement in electrical device or apparatus. With the opening of the New Year they announce a new form of Leclanché battery, and it will be in shape to put on the market about Jan. 15. As one of its features it will have an immersed lead top, with a cover so arranged as to effectually seal the battery. Partrick & Carter will make a specialty of the improved battery alluded to; and will also continue to manufacture their well-known brass clamp connection in the same general form as embodied in the other. The new indicating bell, manufactured by the above named firm, is meeting with liberal patronage from all sections of the country; and orders for this firm's hotel fire alarm and return call annunciator are received by every mail,

W. I. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 Mallers Building, Chicago, Jan. 4, 1890.

Mr. A. M. Irwin, of Pittsburgh, dined at the club rooms last week.

Mr. Thomas P. Conant, of the United Edison Company, of New York, dropped in to see his friends in Chicago this week.

Mr. George Cutter, Chicago, has kindly favored this office with a handsomely-bound copy of the book of wiring tables he is distributing.

Mr. E. C. Loveland, formerly of Chicago, writes from Raton, New Mexico, that an Edison plant, with Westinghouse engine, is being installed there by Mr. Holloway.

Trinidad, Col., wants a fire alarm system, and the Council are inclined to economize and adopt a makeshift arrangement—a combination of telephone and steam whistle.

Mr. Fred Degenhardt's many friends will learn with regret that he has been confined to his room with an attack of pneumonia, but he will be on hand at Kansas City.

Mr. E. T. Baker, formerly the purchasing agent of the Western Electric Company, Chicago, is now successfully introducing the Yost type-writing machine in Illinois and Wisconsin.

The Pond Engineering Company, of St. Louis, are installing the sixth Armington & Sims 150 h. p. engine ordered by the Edison Electric Illuminating Company of New Orleans, La.

Mr. D. A. Andrews, Jr., of Pettingell, Andrews & Co., Boston, expects to have the Hyde-Herr switch ready for the market in time to solicit orders for the same at Kansas City in February.

The Naperville Electric Company, at Naperville, Ill., has been formed to construct and maintain an electric light plant; capital stock, $12,000; incorporators, R. E. Travis, C. C. Travis and A. J. Travis.

The Gate City Electric Railway, of Dubuque, Ia., was formally placed in operation last week. The construction of the entire plant was supervised in the interest of the railway company by the firm of Bliss & Bell, of Chicago.

The Altoona Manufacturing Company, Altoona, Pa., are placing one of their new type of automatic cut-off engines that is specially adapted for electric light service in the station of the Edison Illuminating Company, of that city.

The Mills Interlocking Switch and Signal Company has been formed at Chicago to manufacture interlocking railroad signals and switches, etc.; capital stock, $1,000,000; incorporators, F. J. Hoyt, Milton Weston and M. B. Mills.

Mr. Whipple, the fire reporter of the St. Louis Board of Underwriters, has formally reported that there was not a live electric wire in the Guernsey-Scudder building when it caught fire, and that the fire was in no sense due to electricity.

The Darché Electric Company, Chicago, have received a large number of orders from all classes of early risers for their unique electric alarm clock. Electric street railway men, factory employès, railroad men and others are voluntarily indorsing its efficiency.

Shay, Stephens & Co., of Chicago, are preparing a handsome souvenir that will be sent on application to all users of insulators and battery jars throughout the world, and which will be appreciated as highly as the convenient pocket memorandum book they distributed.

Mr. George H. Bliss has returned to Chicago from a successful business trip to New York. Mr. Bliss has perfected arrangements enabling him to properly exploit any device of value in the operation of electric railways, and thus can render able assistance to inventors in that line.

Mr. F. J. Baker, manager of the Chicago office of the Daft Electric Company, has recently installed a 7 h. p. motor in the printing office of George E. Cole & Co., 78 Dearborn street. Besides running the printing office, the motor supplies power to run the freight elevator, and, notwithstanding the fact that Mr. Cole has his own engine and boiler in his basement, he has found it more economical to use the motor, thereby effecting a saving of about $20 per month in running expenses.

Mr. Ralph W. Pope delivered an interesting lecture regarding the "Past, Present and Future of Electricity" on the evening of Dec. 23, before the electrical section of the Mechanics' Library and Reading Room Association, at Altoona, Pa. The lecture was the same as that delivered by him before the Franklin Institute a week or two previously.

Pittsburgh Construction Companies Consolidate.—The Keystone Construction Company, the F. S. Marr Construction Company and the Washington Carbon Company were consolidated Dec. 27 under the name of the North American Construction Company, with a capital stock of $500,000. One of the heaviest stockholders is George Westinghouse, Jr.

Window Attractions.—In the show windows of a Chicago clothing house are two large globes designed to represent the world, and which are kept slowly revolving by the aid of an electric motor. In front of the globe in one of the windows is a neatly-painted sign, reading: "We own this world and the next," with a hand pointing to the globe in the adjoining window. It is electrical, and, of course, attracts attention.

The Allegheny Illuminating Company.—A decree was made last Saturday dissolving the Allegheny Illuminating Company. The petition asking for the dissolution stated that the company was chartered April 21, 1888. The purpose was to furnish light by means of electricity in Allegheny City. The company never went into business, and in November last it was agreed by a majority of the corporators to ask for a dissolution.

Ball Engines in the West.—Beginning with Jan. 1, Mr. W. B. Pearson will represent the Ball Engine Company, with headquarters at room 40', Home Insurance Building, Chicago. His territory will include Illinois, Iowa, northern Indiana, Wisconsin and Michigan, to the east shore. Mr. Pearson is favorably known to engine buyers in Chicago and surrounding territory, and the large and growing business of the Ball Engine Company will no doubt be still further extended under his management.

Arc Lamps on Edison Circuits.—The Edison Illuminating Company, of Altoona, Pa., are reported to be supplying arc lights from their Edison circuits to consumers who prefer the same to a cluster of incandescent lamps. The company are said to have found that the improved Schuyler arc lamp is best adapted for the purpose, owing to its simple adjustment. The service wires running from the pole circuit or "main" are of high resistance. German silver having been used in some cases; they present a neat appearance, and the service gives excellent satisfaction.

Mr. E. T. Ramer, of Geneseo, Ill., is in the city arranging with Manager Keeler, of the Keystone Construction Company, for the installation of such lights as the City Council may select for street lighting. Mr. Ramer says that the visit of the Council to Sterling, Ill., where they had ample opportunity to inspect the system, has about convinced them tha street lighting can be done as effectively with the Westinghouse 32 c. p. incandescent lamp as with the arc lamp. He presumes that an incandescent system will be selected, and that at least 100 thirty-two c. p. lamps will be burning within 60 days.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, Chicago, furnishes quotations on telephone stocks as follows:

Chicago	$308@$310	Cumberland	$ 68@ $69
Central Union	58@ 59	Wisconsin	114@ 115
Michigan	95@ 98	Bell of Missouri	150@ 151
Great Southern	31@ 32	Iowa Union	23@ 25
Colorado	35@ 38	Missouri and Kansas	57@ 58
Rocky Mountain Bell	40@ 41		

ELECTRIC LIGHT STOCKS.

Chicago Arc Light and Power	$73@$76	Chicago Edison Co	$105@$106

Christmas Gifts at Pittsburgh.—In the Westinghouse Manufacturing Company's establishment, everybody appeared to remember everybody else. Robert D. Barry was presented with a marble clock, Edward Davis with a handsome gold-headed cane, Mr. Jackson and T. Kearney each with a 20-pound turkey, Isaac De Raiser with a diamond stud, and Mr. Nolan a monogram ring. Mr. Bell, of the armature room, was given a sewing machine. Mr. Patterson made the presentation speeches. Morris Mead, chief of the City Bureau of Electricity, was most agreeably surprised by the receipt of a magnificent Elgin hunting-cased gold watch from the attachés of the bureau, the presentation address being made by John W. Moreland.

Mr. M. A. Knapp, manager of the Knapp Electrical Works, Chicago, controlling the sale of the Perkins incandescent lamp throughout the Western States, says that the secret of success in the manufacture of incandescent lamps lies in the selection and use of a high grade of lead glass prepared at one blast under certain known conditions, and, after the bulb is blown, in securing a perfect vacuum therein; and then in sealing the lamp tightly, all conming to insure long life with high efficiency and non-discoloration of the bulb. These points have been given special attention by the Perkins Company, which accounts for the popularity of and the heavy demand for their lamp. Mr. Knapp furnishing over 10,000 lamps per month to his customers in the West.

Dr. A. F. Mason, general manager of the Simplex Electrical Company, of Boston, dined with George Cutter at the club rooms last Saturday. In speaking of the large amount of business transacted during 1889, Dr. Mason said that practically all of that received during the last six months had come to him unsolicited, and that the receipt of orders for carload lots of wire were to be delivered at stated intervals had compelled the company to install over one hundred new braiders, and that an additional hundred would be placed in operation early this year. Dr. Mason further said that although they had orders on hand for future delivery, that, in the event of no more being received, would keep the factory running in full operation for the next three months, yet the stock on hand was always kept up, and thus prompt shipments could certainly be relied on.

Chinese Capitalists in Pittsburgh.—Kwong Yen and Fong Wong, the two Chinese capitalists who are traveling in this country inspecting the different electric systems, arrived in Pittsburgh last week, and were the guests of one of the officers of the Westinghouse Company. The former gentleman will stay there several days, while his companion will journey on to San Francisco. After inspecting part of the plant of the Westinghouse Company, the gentlemen put in their time traveling about the city investigating the workings of the street arc lights. The two Chinamen are representatives of a syndicate in China, who have secured a 90 years contract to light the principal cities of the empire. Their headquarters are at Canton, where they will soon have one plant in operation. The latter was shipped from Pittsburgh, about three months ago. Another man is wanted to go from Pittsburgh to operate the plant.

St. Louis, Mo.—The following data are from the first report of the construction company to the South Broadway Street Railway directors. Five motors, five trail cars, two 10 h. p. motors to each car. Worst piece of track in the United States; 13 sharp curves,

miserable roadbed, poor rails; no extent of straight, level track; 3,900 car hours (during month of trial), 16,590 miles; seven per cent. lost time—one per cent. due to motors, two per cent. due to poor construction and workmanship, four per cent. due to track and roadbed. Loss of only seven per cent. is unprecedented in the history of electric railways. Cost of running one car one car day, $2.50½ The new equipment on this line now approaching completion is as follows: Three miles new track new overhead construction, substantial and graceful patent hangers, insulators, clips and curves; thirteen motors, eight trail cars; 350 h. p. Wheelock engine and steam plant complete; switch board, lightning arresters, ammeters, voltmeters, safety guard wire and alarm signal, incandescent lamps, transfer tables and every modern appliance for power station and cars.

Mr. Emerson McMillin, of St. Louis, recently said: "The question of compounding engines, that is, making a specified amount of steam do its work twice, three, four or more times, and again, by condensing this same steam and by producing a vacuum, making the atmosphere add its force to that of steam, is one that has for a long time received attention from mechanical engineers, especially in the navy and merchant marine. The ordinary high pressure engines as we use them in this city gives for every 30 pounds of water evaporated into steam one indicated horse-power per hour. In other words, we use under the most favorable conditions and the most perfect management of furnaces three pounds of coal to produce this result. Now by compounding engines or by even going to the point of using triple expanding machines, as I shall do in the electric light plant at our works, we can get one indicated horse power per hour from 12 pounds of steam or with one and two-tenths pounds of coal. This method of using steam is not, however, economical except when you can get plenty of free water for condensation purposes, as it requires one and a half gallons of water per indicated horse power per minute."

Electrical Insurance.—Dr. Louis Bell, of Chicago, has become somewhat interested in the proposed plan of forming a Western company for the insuring of dynamo electric machinery from loss by fire from any source, and especially by reason of a short circuit occurring accidentally. In conversation with the leading officials of certain insurance companies, Dr. Bell learned that the standard insurances companies will gladly welcome the coming of a company organized for such a purpose, and will certainly join hands in helping it on to success. Owners of plants will as certainly encourage and patronize any company organized on a responsible basis, and offering a thoroughly matured plan of underwriting, while the proposed company will not run much more than the average risk, owing to the small per cent. of "burn-outs" that have occurred in the machinery sent out by the leading parent companies during the past three years, as referred to in The Electrical World of July 13, 1889. Dr. Bell also believes that the "moral hazard" is now eliminated to a large extent, owing to the personal character and high social standing of the majority of the gentlemen controlling lighting and power plants. This moral hazard may have been a bugaboo in the early days of the industry, but it should no longer cut a figure where the owners are men of known probity.

The Duluth, Minn., Electric Light and Power Company has had a year of wonderful growth, having added to its plant two seven hundred and fifty 16 c. p incandescent dynamos of the Westinghouse alternating current system, purchased the lot and building where it first located on Michigan street, thus doubling the amount of real estate owned by the company, and increased its steam appliance by the erection of a large brick stack and by the purchase of another 175 h. p. engine and a 500 h. p. boiler of the Scotch marine type. In the prosecution of its business for the year it has paid for labor and construction nearly sixty thousand dollars, and has wired seven of the finest business buildings in the city, including Temple Opera and a large number of the most costly private residences; has more than doubled its production of incandescent custom, and is still far behind on its orders for new work, being unable to secure a sufficient supply of material and skilled labor for the rapidly increasing demand for that form of light. The outlook for the coming year is for a still greater increase in electric lighting by this company than even in 1889, but as facilities have grown with the demand, the company believe it will be able to take care of almost any quantity of business. Its paid-in stock is $75,000, almost exclusively held in Duluth. J. F. Patten is president and general manager and Mr. Burgess is superintendent and electrician.

Mr. W. J. Phelps, of Elmwood, Ill., was a visitor to Chicago during the week. Referring to the electrical plant installed by him in the Elmwood Coal Company's mine No. 4, Mr. Phelps stated that the dynamo and junior Westinghouse engine of 15 h. p. were placed in the large engine room to avoid the necessity and the expense of extra attendance. The Okonite insulated wires are carried above ground for half a mile, and then passed through a one-inch iron pipe, previously driven down a bored hole, to the lower level and to the 5 h. p. motor that drives a rotary pump that is giving excellent satisfaction, though not always deemed the best for mining purposes. Sprague graphite brushes are used and the speed is maintained at 1,200 revolutions. The discharge pipe from the pump also passes through a bored hole to the surface. Mr. Phelps states that the saving effected equals the pay of two men in this one service, and that the company are now arranging for the installation of a motor to drive the ventilating fan, and thus do away with the expense of maintaining an extra furnace. This arrangement, Mr. Phelps says, will also permit of fresh air being secured through a new shaft placed directly above the point of work, instead of being drawn through a long and winding shaft as heretofore. The proper location of the air shaft and of the wires is easily secured by surveying from within the mine to the main shaft and then out to the proper point. Mr. Phelps is very enthusiastic on the subject of the application of electricity in mining, and has already devised some improvements of his own for mining service.

Fuse Wire.—The Electrical Supply Company, Chicago, have issued a circular, No. 596, that is a dainty little pocket companion for every one connected in any way with the installation or operation of light and power plants. Therein they say: "Of the many devices which have been adopted for automatically opening circuits, when the current becomes too great, the fuse is considered not only the simplest, but when accurately determined, the most reliable. The proper size and determination of the quality of the material entering into fuse wire involves much calculation, for while the exact law of temperature elevation with regard to the sectional area of the wire is known, there are several variables which enter into its practical working. As the temperature of the wire increases its conductivity decreases. The heat generated, owing to its rising resistance, is a more abrupt curve than is usually supposed. As the sectional area increases the external surface is also increased, dissipating more heat. All these conditions have been carefully studied and we have devised a system of alloys for each different carrying capacity, or size of wire. This, together with accurate determination by careful tests, has given us an article unparalleled for accuracy and reliability. The smaller sizes of our wire fuse at about 100 per cent. above their normal carrying capacity, as the current involved represents but a small amount of energy, the danger element thereby being reduced, while quite large variations in the current are admissible before blowing of the fuse occurs. The medium size fuse wire melts at from 40 to 60 per cent. above the normal, decreasing as the size grows larger, while the larger wires, from 60 ampères up, go down even to 20 per cent. in advance of the normal. The conditions and surroundings of a fuse wire vary its melting point greatly. If inclosed, it melts much sooner than if exposed. The above percentages are calculated upon the fuse being inclosed, which is the more usual. In the table given will be found the fusing current under both conditions." As the supply of these circulars is limited, parties desiring a copy should apply speedily. F. Del.

Lima, O., Jan. 1, 1890.

Lots of Light.—There are about 16,000 to 18,000 people here. Our streets are lighted by some 130 arc lights and the commercial circuits have 70 more. The Thomson-Houston system is used; also one Thomson-Houston alternating, 750 or 900 light machine, and two Thomson-Houston direct incandescent machines. There are also lots of motors here.

Gamewell System Fire Alarm.—The Fire Department of this city will put in the Gamewell system. Part of the lines will be strung on the Telephone Company's poles. The Lima Electric Light and Power Company refused to allow them the use of their poles. They would, however, allow the Council to use their poles provided they employed insulated wire. The Gamewell people have commenced the contract.

The National Transit Telegraph Company (*i. e.*, Standard Oil Company's telegraph) work the phonoplex from Lima, O., to Oil City, Pa., a distance of 263 miles. They also have Cleveland, O., on this same wire. There are in the neighborhood of some 300 to 400 messages a day handled on this phonoplex. It is a copper wire and works like an old trip hammer; it comes nearly as loud as a telegraph sounder. There are ten cells of Bunsen carbon battery, cylinder zinc type, at Lima, and a proportional amount at Cleveland and Oil City. All lines of this company in the State of Ohio are copper, and a fine telegraph department they have. Mr. W. W. Splane is superintendent at Oil City, Pa., while E. E. Linn, an "old timer," is manager at Lima, O.

SOUTHERN NOTES.

Texarkana, Tex., Dec. 17, 1889.

The Texarkana Gas and Electric Light Company have just finished their new station at a cost of $15,000. They are using one incandescent United States machine of 300 lights and two of 200 lights each, and one Van Depoele arc machine of 60 lights. They have also one 750-light Westinghouse alternating machine. They have at present orders enough to load them up to their full capacity. They have just wired up the new Union Depot, one of the finest in the South. They have a contract from the city for 26 more arc lights for the streets, making 46 in all, and will have to add another arc machine at once. Mr. Boyd Anderson, the superintendent and electrician, has constructed for the Methodist Episcopal Church for Christmas a star of incandescent lamps, which will be put in a window, and at the right moment of the Christmas service switched into light, to represent the Star of Bethlehem. The effect is striking and beautiful. Mr. E. N. Maxwell is President of the company, and Mr. T. E. Walters, Secretary.

ENGLISH NOTES.

(*From Our Own Correspondent.*)

London, Dec. 18, 1889.

The Silvertown Strike.—A strike of the employés of the India Rubber, Gutta Percha, and Telegraph Works Company, which has lasted for some two months, finally collapsed last week. The victory of the company is chiefly due to the fact that they have been able to carry on urgent work at their factory in France. It is generally felt that these strikes, always a nuisance, are now becoming a danger, and the defeat of one or two of them will be generally welcome to the community.

Prof. Rowland and the Royal Society.—Among those who were elected to foreign membership of the Royal Society last week was Prof. Rowland, for his determination in absolute measure of the magnetic susceptibilities of iron, nickel and cobalt; for his accurate measurements of fundamental physical constants; for the experimental proof of the electro-magnetic effect of electric convection; for the theory and construction of curved diffraction gratings of very great dispersive power, and for the effectual aid which he has given to the progress of physics in America and other countries.

Municipal Electric Lighting.—The want of reality about the municipal proposals for electric lighting in this country is now becoming tolerably evident. A few weeks ago I referred to the fact that no less than fifty towns had announced their intention of obtaining electric lighting powers. This number may now be reduced to forty, and will, doubtless, suffer still further diminution in the immediate future. The local authorities, finding that the electric lighting companies did not persist in their own applications in face of the local opposition, are now quietly dropping one by one out of the race. The great amount of work which will have to be done in the course of the next twelve months makes this default on the part of the local authorities of no great consequence; but it is to be hoped that the Board of Trade will take care that this game of hide-and-seek is not renewed when the companies again send in their applications.

The Electric Lighting Accidents.—The alarming reports which have reached, and continue to reach, this country from your side of the water, of fires, fatal accidents and severe injuries arising from the use of electricity in any and every shape, although received by the electrical fraternity with a considerable amount of salt, have had the natural effect of creating something in the nature of a mild panic in this country. Hardly a single local authority in the United Kingdom can now discuss the matter of electric lighting without a reference to the "big fire at Boston," or the "horrible accidents in New York," which form an excellent pretext for opposing the electric light. The exposure of several of these sensational stories by the American and English technical press, although of some use, does not have as much effect upon the public mind as the sensational stories themselves. English electrical engineers, therefore, would much like to see an end of this weekly record of accidents, for their own sake as much as for the general credit of electric lighting.

The Metropolitan Electric Light Company.—Although the directors of the Metropolitan Electric Light Supply Company are unable at present to show a dividend, they are in a position to announce the next thing to it, namely, constant increase of business. In the report to be presented at the general meeting this week the directors state that the "existing demands for the electric light far exceed the company's supply, even if all its authorized capital had been all called up and expended on installation works." It is, therefore, proposed to issue debentures so as to avoid increasing the share capital at any rate for the present; but the directors anticipate that if their business develops in the future as it has been developing in the last twelve months, the capital of the company (£500,000) will have to be increased to two millions sterling. This company has at present at work the following stations in the metropolis: The battery station at Whitehall, where the demand for current is in excess of the supply; the Westinghouse station in Sardinia street, which commenced working on Sept. 21 last, and where the demand for light is so much in excess of its present capacity that it has been lately decided to double the plant; and the alternate current transformer station in Rathbone Place, Oxford street, which is a small concern, and which is also worked to its full capacity. The following stations are in course of construction: a large alternate current transformer station in Manchester Square, which, it expected, will commence operations next spring; a large alternate current transformer station at Waterloo Wharf, which is nearly ready to go into operation. In addition, the Metropolitan Company have under consideration the erection of a station to supply the Strand district another one to supply the western portion of the city, and a third one to supply the large and populous district of Paddington. This company, it will, therefore, be seen, has thoroughly settled down to work. So far, the preference of its directors for several medium-sized stations as against one huge one, as at Deptford, has been amply vindicated, for while the Metropolitan Company has three stations in full operation, their colossal rivals have not as yet been able to bring into commercial use even their 1,500 h. p. machines, not to speak of their 10,000 h. p. dynamos.

THE TELEGRAPH.

Shelton, Conn., proposes to put in a fire-alarm system.

The Commercial Cable Company have issued their usual large-figured calendar, and have accompanied it by a circular of tariff, rules and regulations.

The Southwestern Railway Company will build a road with telegraph line, from a point between San Diego and Los Angeles to Cajon Pass, in San Bernardino County, a distance of 220 miles.

The New York District Messenger Boys were entertained on New Year's Day by Mr. C. E. Vernam, the proprietor of the Morton House. The boys behaved very nicely, and the dinner was, like its predecessors, quite a success.

T. M. B. A.—The Association has issued a neat little folder, giving some facts about itself, and making some excellent arguments for insurance, which telegraphers will do well to take heed of. The Association now has a reserve fund of $87,000.

The New York Telegraph Club, composed mostly of men working for the Western Union Company, has lost about $2,000 worth of furniture, &c., in its rooms at 50 Church street. Fire was discovered in the parlor, which is on the third floor of the building, about 8 o'clock A. M., Dec. 31. Firemen from an engine company near by confined the flames to this room and no alarm was sent out. The building was damaged about $300.

The Aransas Telegraph Company will open at once for commercial business in Texas. It is understood that the company intends extending the wires off the railroad line to places needing communication with the outer world, and that arrangements have been made with the Postal Cable Company by which its lines will be extended from Kansas City to Dallas to meet the railroad line, by which connection will be made with Mexican wires along the route of the Mexican National Railroad from Laredo, Tex., to the City of Mexico. The officers are: B. F. Yoakum, president; U. Lott, vice president, and R. Houston, secretary.

THE TELEPHONE.

St. Helens, Ky.—The St. Helens Telephone Company has been formed by C. B. Lowry, S. P. Stamper and others to build a line to Beattyville.

Alabama.—The United States Government will construct a telephone line from Milton's Bluff at Mussel Shoals locks to the mouth of Shoal Creek, 23 miles.

The Yaquina Bay Telephone Line Company has been formed to run a line from Toledo to Yaquina City, Ore. The capital stock in $1,000. B. F. Jones, J. H. McNeil and B. Garther are the incorporators.

Phonograph Suit.—Ezra T. Gilliland and John C. Tomlinson, against whom Thomas A. Edison brought suit in the United States Court some time since for fraudulently disposing of his interest in the phonograph to the Edison Phonograph Company, filed last week a demurrer to the complaint, which will be heard by Judge Wallace during the present week.

THE ELECTRIC LIGHT.

Mt. Sterling, Ky., will put in a Thomson-Houston plant.

Vernon, Tex., is to give out a contract for an electric light plant.

Little Rock, Ark.—The Edison Electric Light Company will enlarge its plant.

Brenham, Tex., is to have an electric light and ice plant. D. C. Giddings is interested.

Malvern, Ark.—An electric light company is being formed. D. D. Maddry is interested.

Frostburg, Md.—The Frostburg Gas Light Company is going in for general electric lighting.

Rogers, Ark.—A. Bucklin is interested in the construction of a proposed electric light plant.

Montgomery, Ala.—It is said that the Ball Electric Light and Power Company may put in a plant.

Charlestown, W. Va.—The Kanawha Electric Light Company is to put in 150 h. p. of engine and boiler.

The Queen City Electric Light Company, Gadsden, Ala., has increased its capital stock by $15,000.

Pine Bluff, Ark.—E. L. Colburn wants an incandescent plant of 60 to 80 lights for a flour mill and grain elevator.

Meridian, Miss.—The Thomson-Houston Company will enlarge its plant, and has increased its capital stock to $50,000.

Edenton, N. C., will probably have an electric light plant. The Branning Manufacturing Company will enlarge its plant.

Cincinnati, O.—The Brush Company has secured the contract for city lighting for 10 years, at the rate of $59.98½ per year.

Pocomoke City, Md.—The Pocomoke Electric Light Company will put in a new boiler, engine and dynamo in the spring.

Birmingham, Ala.—The Birmingham Gas and Electric Light Company will put in a 50-arc Thomson-Houston dynamo.

Fremont, O.—The plant of the Fremont Gas Company has been sold to Mr. F. Heim, for $41,000, for the Fremont Electric Light Company.

Snow Hill, Md.—The Snow Hill Electric Light and Power Company has been formed by J. P. Moore, W. S. Wilson, C. J. Purnell and others.

Kewanee, Ill.—The Kewanee Electric Light and Motor Company has been formed by C. E. Barry, J. E. Blish, and F. P. Pierce, with a ca ital stock of $12,000.

Saratoga Springs, N. Y.—A new gas and electric company, with a capital of $100,000, will begin operations next spring, having recently secured a franchise.

Alternating Arc Lights.—Mr. G. Westinghouse, Jr., promises that a new and excellent alternating current arc light will be supplied immediately, and will be put into use at once in New York.

The Milledgeville, Ga., Electric Light Company has been incorporated by W. T. Conn, T. O. Powell, W. S. Brooks and others to erect and operate an electric light plant and build gas and water works. The capital stock is $10,000.

Xenia, O., reports having had a poor experience with its municipal plant, while a private company, started about a year ago to supply arc and incandescent light, has built up a good profitable business, and sold out to the gas company at a premium.

Interest in the Convention.—The Kansas City papers are taking the greatest possible interest in the February convention of the National Electric Light Association, and among other items are printing notes as to the prominent men who will take part in the proceedings.

Oldtown, Me., is to have an electric lighting plant in operation very soon. The other day a representative of the Westinghouse Electric Company closed an order at that place for a 750 light alternating current dynamo, and this machine will be shipped from Pittsburgh immediately.

New York City.—Wire cutting has been partially suspended, and the local companies are to bring suit against the city for damages in a large amount. Merchants and manufacturers all over the city are writing to the papers protesting against the political jobbery that has caused them the loss of their light and power.

Cowansville, P. Q.—Mr. G. K. Nesbitt writes that the plant at Cowansville consists of 300 incandescents of 16 c. p. driven by water power. An additional water power has just been placed to drive an arc plant of about 15 lamps of 2,000 c. p. The present water power in use is about 56 h. p., obtained from two "Little Giant' wheels of 24 inch, under 13 foot head. The plant is run by a small stock company of $12,000 capital, of which $7,600 is paid up. Mr. Nesbitt owns the power buildings and a large part of the stock, and acts as manager. He is now in the market for the proposed new arc plant.

The Westinghouse Electric Company secured contracts for alternating current apparatus during the first three weeks of December for the following central stations: Salem, O., 750 lights; Louisville, Ky., 750 lights; Greenfield, Mass., 750 lights; Denison, O., 500 lights; St. Louis, Mo., 2,500 lights; Hamilton, Ont., 1,500 lights; Denver, Col., 3,000 lights; Pittsburgh, Kan., 750 lights; Pueblo, Col., 750 lights; McKinney, Tex., 500; Portland, Ore., 6,000; Lynchburg, Va., 750 lights; Dansville, N. Y., 500; Batavia, N. Y., 750; Pittsburgh, Pa., 3,000; Oldtown, Me., 750. Arc light machines of a capacity of 250 lamps sold: To Pittsburgh, Kan., 50; Portland, Ore., 100; New Bedford, Mass., 100.

A Hint to Legislators.—Discussing the electric scare, the San Francisco *Journal of Commerce* says: "Look at the killed and wounded chargeable to our cable system of transportation. Add to these those who have been sacrificed upon our railroads, and in our ship yards and machine shops. Still we must be moved from place to place, and our machinery cannot remain idle. We must have light, and heat, and power, or be deprived of the necessities and comforts of existence. That life and property should be carefully and properly protected we do not deny, but when the questions of protection are to be settled by legislation, there are so many factors that enter into the subject, particularly when competing commercial interests are at stake, that it behooves the legislators to be very cautious and careful lest more harm than good be done."

Clay City, Ky. has the facilities for being the largest of any of the new towns in the South, and its lighting plant is entirely in keeping with the general attractiveness of the place. The city was laid out by the Kentucky Union Land Company, who control the place and the results have been more than satisfactory. No two buildings are alike, each house being of a modern design, handsomely finished, having for a background lofty and picturesque mountains, making the scene most gorgeous. The lighting plant, occupying a very prominent location, is of brick with Kentucky marble trimmings, three stories high. The first floor is occupied by the dynamos and engines with a floor space 38 × 68 feet, the second by the offices, and the third by workshops and storeroom. The dynamo room is finished in curly poplar and quartered oak, with hard oil finish, and the walls are of painted brick, making a decidedly pleasing effect with its bright machinery. The boiler house is 200 feet from the plant, thus getting rid of the dust and smoke, and contains four Wickes Bros. tubular boilers, 16 feet long and 66 inches in diameter, which furnish steam for one Buckeye engine of 140 h. p., which runs three No. 12 Edison dynamos of 500 lights capacity each, making a total of 1,500 lights. One hundred 32 c. p. lamps are used for street lighting, five hundred and twenty 16 c. p. for the saw and planing mills, which are the largest in the South, the remainder for stores and residences. The plant is now working up to its capacity and will shortly have to be increased to meet the growing demands made on it. Mr. G. R. Scrugham is the electrician.

APPLICATIONS OF POWER.

Asheville, N. C.—The West Asheville Improvement Company will build a six-mile electric railroad to cost about $15,000.

Winston, N. C.—Northern capitalists have bought the plant of the Winston Electric Light Company and will build a two-mile electric road.

Covington, Ky.—The Covington & Cincinnati Street Railway Company has closed a contract with the Short Electric Company, of Cleveland, O.

Spokane Falls, Wash.—The road of the City Park Transit Company, through Lidgerwood Park, is to be put in on the Thomson-Houston system.

Mossy Creek, Tenn.—Mr. J. E. Clark wants to transmit water power by electricity two miles, and would like estimates on a plant—turbine, dynamo, motor, etc.

New Brighton, Pa.—The New Brighton Electric Railway Company has been formed by J. R. McKee, F. K. Brierly, W. C. Simpson and others, with a capital stock of $50,000.

New Orleans, La.—The Crescent City Street Railway Company has accepted the proposition of the Electric Traction and Manufacturing Company to equip its line with storage battery cars.

Little Rock, Ark.—The Citizens' Street Railway and the Little Rock Street Railway have been purchased by a syndicate of Chicago capitalists for $250,000. It is proposed to put in electric motors.

Birmingham, Ala.—It is rumored, says the Baltimore *Manufacturers' Record*, that the dummy lines recently mentioned as consolidated will be converted into electrical railways. W. W. Walker, Jr., can give information.

An Underground Railroad in Buenos Ayres.—Buenos Ayres is to have an underground railroad. It will be lighted electrically, and is to be ready for traffic in three years. The cost of construction is placed at about $6,000,000. After a period of 90 years the road is to become government property.

Albany, N. Y.—In the matter of the application of the Hudson River Telephone Company for a temporary mandamus restraining the Watervliet Turnpike Company from using the single trolley system, until the courts can decide as to a permanent injunction, Justice Mayham has granted the application.

Orange, Mass.—The electric railway project to run between Orange and Athol, Mass., is meeting with sufficient encouragement to warrant the belief that it may be carried into effect by another season. The subscribers in Orange are John W. Wheeler, W. L. Grout, W. M. King, F. A. Dexter and F. P. Carruth.

The New York City Suburban Surface Railroad Company has been incorporated with a capital of $200,000 and permission to increase the capital stock to $1,000,000. The company will operate electric motors run by storage. Among those interested are ex-Mayor Edson, H. N. Camp and D. D. Conover.

Beverly, Mass.—At a meeting of the Beverly & Danvers Electric Railroad Company, held last week, it was voted to lease the road to the Union Electric Car Company, who are at present operating the road with their storage battery system. The Union company will guarantee a certain per cent. for dividends, and will extend the tracks in Beverly and Danvers. They will also ask permission of the railroad commissioners to allow them to run over the Naumkeag street railroad tracks as far as Pleasant street in Beverly and the square in Danvers.

Leetonia, O.—The Leetonia Electric Light and Power Company have a two years' contract for 80 lamps of 25 c. p. Their plant is situated in Leetonia, a town of 3,500 inhabitants, and three and a half miles from Columbiana, of 30,000. They have one Fort Wayne Jenney 600-light alternating machine, one 12 × 16 Buckeye engine, and one 48 × 18 Leetonia Boiler Works boiler. Their dynamo is running at full capacity, and, in the course of a few months, they will put in another one. Mr. J. C. Thullen is president and treasurer, and Mr. L. H. Thullen, secretary and manager.

The Peral Boat.—A dispatch from Madrid, of Dec. 27, says: Telegrams from San Fernando describe the brilliant navigation trials performed yesterday by the Peral. The submarine torpedo boat traversed under water twenty-five miles, remaining submerged four hours. The reappearance of the boat aroused immense enthusiasm. Cadiz is wild with delight. In Madrid also there is tremendous enthusiasm. On Sunday, Dec. 29, the definitive trials will take place in the presence of the Minister of Marine and a naval commission. The greatest expectancy prevails.

"The Worst Species of Raiding."—*Light, Heat and Power* says: "The question of municipal control of lighting is one that is growing steadily in importance, and one that it will not do for the gas and electric companies of the country to slight in consideration. Agitation in this direction has steadily developed during the present year, and a noticeable feature of the matter is that the rights of the companies are seldom considered, excepting after an arbitrary method that proposes placing the determination of their value virtually in the hands of the municipal authorities. The acquisition, by cities and towns, of electric lighting plants, has been largely instrumental in whetting the appetites of local legislators for more worlds to conquer, and the territory of the gas company stands temptingly near. This will prove the worst species of raiding invested rights that we have yet experienced in the gas fraternity, and the sooner some united action is taken in defense, the better for the interests at stake."

A New Electric Railway Trolley.—The Rochester *Post-Express* says: "A new trolley, which has been tested on the electric road to Charlotte, is found to possess so many desirable features not found in others, that it is likely to be adopted by the companies throughout the country. The most evident advantages which it is seen to possess are that at the end of a line it reverses automatically and without any assistance from the conductor, who is not obliged to get off the car as with the common trolley. This feature saves a great deal of time, especially when the direction of a car has to be changed in a crowded street, and the driver has to pick his way among the other vehicles from one end of the car to the other. The operation of reversing the car was performed in 20 seconds. The trolley is not removed from contact with the wire, and the electric lights never go out as they do at present. President Soule, of the electric road, thinks so well of the invention that he said: 'It overcomes the one weak point of the trolley system—the necessity for transferring the trolley by hand when the direction of the car has to be changed.' The device was invented by Harry P. Roberts, of this city."

PERSONALS.

Mr. S. Insull, of the Edison General Company, and manager of the Edison Machine Works, etc., has just recovered from a severe attack of pneumonia induced by "la grippe."

Mr. W. H. Coleman, superintendent of the Northampton, Mass., Electric Light Company, has accepted the superintendency of the Citizens' Electric Light Company, of Wichita, Kan.

Mr. W. L. Heger, Pacific Coast agent of the Edison United Manufacturing Company, has bought out the Electric Development Company, and has reorganized the Edison selling agencies in his territory.

Mr. John Begley, the superintendent of the Gloversville, N Y., Electric Company, has in hand the construction of a $100,000 plant of the Thomson-Houston system. It will be completed for operation by Feb. 1.

Mr. J. B. Kent, one of the oldest employés in the office of the Metropolitan Telephone Company in this city, died suddenly Jan. 2, of apoplexy, after recovering from an attack of "la grippe." He was a near connection of the well-known Governor Kent.

Col. John A. Hinsey, of Milwaukee, who is actively interested in the electric roads there, intends to run across the street, between the poles, light arches to carry the electric railway wires. Something similar was proposed a few years ago by Professor Sweet for arc light wires, and was illustrated in this paper at the time.

Mr. W. S. Mallory, of Chicago, who is associated with Thomas A. Edison in producing certain contrivances, was in the city to-day, says a Pittsburgh dispatch of Dec. 31, en route to Akron, Ohio, having been called there by the inventor for consultation. Mr. Mallory said that several new inventions would be heard of soon, but he was not in a position to particularize.

Mr. Geo. d'Infreville, well known as the former electrician of the Western Union Telegraph Company, has opened an office as electrical engineer and expert, and proposes to devote himself to all work of a consulting nature as well as testing. Mr d'Infreville's varied experience will no doubt be availed of by many. His office is at 110 Liberty street, this city.

MM. G. de la Touanne and **Seligman-Lui,** French government telegraph engineers, have just arrived in this country, on a tour of inspection of our telegraph and telephone systems, They will also devote some attention to electric lighting. M. de la Touanne will be remembered as the author of the report on telephony submitted to the late congress of electricians at Paris.

Mr. W. J. Hammer, who installed and had charge of the magnificent Edison exhibit at the Paris Exposition, has just returned home, covered with glory. In addition to his onerous work connected with the Exposition, Mr. Hammer accompanied Mr. Edison on his trip through Germany, where he was on old pioneer ground, having been one of the first representatives there in years gone by of the Edison electric light. Mr. Hammer, moreover, went in for scientific ballooning, and made one trip of 100 miles through the air, during which he secured a variety of interesting static and magnetic data. Mr. Hammer has by this last European experience added to his laurels as an electrical expert and engineer, and by his remarkable success at the Exposition earned among his intimates the name of "the electrical Barnum."

Mr. George D. Capen, a prominent insurance agent, of St. Louis, said to a *Globe Democrat* reporter recently: "The statement is frequently made that the proximity of electric light wires to mercantile business places prejudices the insurance. Now the man who says that isn't posted on insurance matters. The fact is, I have insured several electric light plants at a less rate than I was required to charge for some stocks of goods. Only eight alarms of fire were caused in St. Louis last year by electric currents, and several of these alarms resulted from the close proximity of the source of trouble to fire engine houses from which people summoned the apparatus to protect adjacent property. I will not charge an extra rate on account of the use of electric lights in any building if the wires are properly insulated, but rather a lower rate."

Mr. W. J. Dealy, chairman of the committee on legislation of the U. S. Military Telegraph Corps, is distributing copies of the excellent bill in their behalf, which enacts "That all persons engaged in the operation and construction of military telegraph lines during the war of the rebellion, are hereby declared to have been a part of the Army of the United States: and the Secretary of War is hereby directed to prepare a roll of such persons, and to issue to each upon application, unless it appears that his service was not creditably performed, a suitable certificate of honorable discharge, reciting this act and the term and character of his service, as well as the relative rank of such person assimilated to that conferred by law upon commissioned officers of the army receiving a monthly pay most nearly approximating that of such person at the time of his discharge."

MISCELLANEOUS NOTES.

The Frankfort Electrical Exhibition.—The International Electric Exhibition to be held at Frankfort, has been postponed until the spring of 1891.

The Wire Metallic and Electric Fence Company has been formed at Chicago by W. D. Rinehart, F. W. Haas, and B. A. Scott, with a capital stock of $500,000.

Sheffield, Ala.—The Hall & Edwards Electric Company has been organized, with E. A. Edwards, president, and J. V. Allen, secretary, to manufacture electrical appliances. The company will meet Jan. 18, 1890, to consider the issuance of $125,000 of bonds.

The St. John, N. B., Electrical Exhibition.—Mr. Ira Cornwall, the secretary of the St. John Board of Trade, has been presented with a handsome bronze clock by the exhibition committee, in recognition of his work. Mr. A. A. Knudson, the electrical superintendent, has also been in receipt of a very handsome letter of thanks for his intelligent, energetic and successful management.

The Camden Manganese Mining and Manufacturing Company, of East St. Louis, has been formed to manufacture manganese, black paint, repairing, building, constructing railroads, telegraph and telephone lines, and doing all kinds of work by contract in the way of mining, construction of canals, etc.; capital, $500,000. Incorporators, A. S. Howard, Richmond Hibberd and H. K. McGrath.

Syracuse, N. Y.—The contractors Moffett, Hodgkins & Clarke, of Syracuse, N. Y., have organized two new stock companies. One is the Electric Engineering and Supply Company, capital $25,000, to manufacture all kinds of electrical machinery and supplies, and the other the Central Electric Construction Company, capital $100,000, to construct electric lighting, power and heating plants and equip street railways.

An Investigation Probable.—It is likely that there will be a legislative investigation of the electric wire and subway troubles in New York City. The subway board expires next November, and it is believed desirable to transfer their powers, not to the Sinking Fund Commissioners, as the law now requires, but to some special and competent body. The grand jury has recommended an investigation, and has stated its opinion that the Board of Electrical Control is deserving of censure.

Accidental Deaths in New York.—The Board of Coroners last year had 4,306 cases sent to them for investigation. Of these, 3,341 were those of deaths due to natural causes, and 965 were matters for investigation. There were 51 homicides and murders. The accidents numbered 732 and were classified as follows: Machinery, 7, electricity, 9; sunstroke, 4; from gravitating objects, 36; falls, 265; burns and scalds, 54; run over by horse cars, 12; run over by cars and engines, 33; run over by elevated railroads, 3; run over by wagons and trucks, 32; shooting, 13; poison, 27; drowning, 170; asphyxiation by gas, 12; miscellaneous, 55.

BUSINESS NOTICES.

Battery Cut-Out.—Attention is called to a simple device for disconnecting gas-lighting batteries if accidently grounded. It is cheap, sensitive, never needs watching, and has no clockwork to be kept wound. Terms furnished by the Electric Supply Company, of Syracuse, N. Y., No. 105 South Warren street.

Protection for Watches.—The Paris Exposition has awarded a medal to the Giles Anti-Magnetic Shield for watches, recog-

nizing it as a practical protection, and the only one in the market. Can be applied to any watch. For descriptive circulars, address Giles Bros. & Co., Chicago, Ill., jewelers and diamond merchants. A fine illustrated catalogue to the trade.

Houston's Electrical Dictionary.—The *Stationary Engineer* says: "This is a book of 650 pages, and is all and more than all its name implies. The author has done something more than make a mere dictionary of electrical terms. It is more like an encyclopedia of the art and science of electrical engineering. The definitions are clear and concise, and wherever illustrations are needed to make the definitions plain the work is thoroughly illustrated. A careful system of cross references is followed, the result being that the student finds without difficulty full and complete definitions concerning any subject either directly or indirectly connected with electrical matters. For engineers making a study of electricity, especially its practical application in the plants under their charge, this work will be invaluable. Every engineer in charge of an electric light and power plant should own a copy. It is not often that a work so thoroughly justifies its title or merits such unqualified commendation."

The Ball Engine Company, of Erie, Pa., have made the following shipments during the month of December: The Brooklyn Street Railway Company, Cleveland, O., three 125 h. p.; Redonda Hotel Company, Los Angeles, Cal., one 100 h. p.; Moss, Tatum & Bowen, San Francisco, Cal., one 25 h. p.; Townsend Electric Light Company, Port Townsend, Wash., one 100 h. p.; United States Improvements on the Mississippi River, one 80 h. p.; Atchison, Kan., Gas and Electric Light Company, one 125 h. p.; Buffalo, N. Y., Street Railway Company, one 125 h. p.; Haverhill, Mass., Electric Light Company, one 125 h. p.; The New Castle, Pa., Steel Company, one 50 h. p.; the New Castle, Pa., Steel Company, one 35 h. p.; Trinidad, Col., Electric Light Company, one 100 h. p.; Edison Electric Illuminating Company, Paterson, N. J., one 150 h. p.; the Boulder, Col., Electric Light Company, one 100 h. p.; Garden City Packing and Preserving Company, Chicago, Ill., one 80 h. p.; Paterson, N. J., Electric Light Company, one 100 h. p.; Gottfreid Krueger Brewing Company, Newark, N. J., one 80 h. p.; Ellensburg, Wash., Electric Light Company, one 100 h. p.; Jas. Hearn & Son, New York, N. Y., one 60 h. p.; Bellingham Bay Improvement Company, Sehome, Wash., one 80 h. p.; Lebanon, Pa., Electric Light Company, one 100 comp.; Citizens' Electric Light Company, Covington, Ky., one 100 h. p. Republican Publishing Company, Denver, Colo., one 60 h. p. D. C. Spruance, Ballston Spa., N. Y., one 60 h. p. comp.; Athens, Ga. Gas Light Company, one 60 h. p.; Buffalo Brewing Company, Sacramento, Cal., one 35 h. p.; Richardson, Smith, Moore & Co., Show Hill, Md., one 50 h. p.; Edison Electric Illuminating Company, Paterson, N. J., one 80 h. p.; Poughkeepsie, N. Y., Electric Light Company, one 100 h. p.; Schuyler Electric Light Company, Hudson, Mich., one 60 h. p.; H. H. Brown, Denver, Colo., one 80 h. p.; H. H. Brown, Cannon City, Colo., one 60 h. p.; Cronk, Horner & Co., Baltimore, Md., one 35 h. p; Edison Electric Illuminating Company, Brooklyn, N. Y., one 250 comp.; Reidsville, N. C., Cotton Mill Company, one 200 comp.; R. Mugge, Tampa, Fla., one 100 h. p.; Norwalk, Conn., Electric Light Company, one 80 h. p.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENT ISSUED DEC. 17, 1889.

11,047. Reissue. Secondary Battery; Joseph Wilson Swan, of Lauriston, Bromley, County of Kent, England, Assignor by mesne assignments to the Electrical Accumulator Company, of New York. Application filed Oct. 16, 1889. Patented in England, May 21, 1881. A perforated or cellular plate for secondary batteries, having the perforations or cells extending through the plate and the active material or material to become active packed in the perforations or cells only.

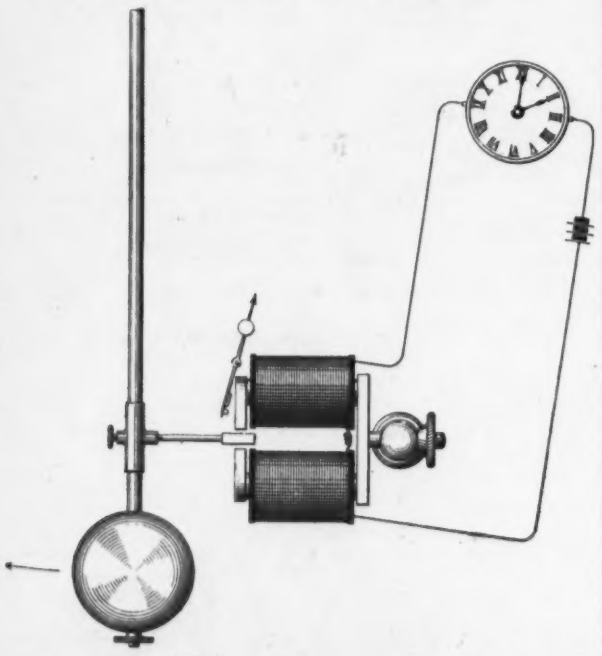
PATENTS ISSUED DEC. 24, 1889.

417,747. Device for Suspending Electric Conductors; Sidney H. Short, of Cleveland, Ohio. Application filed July 30, 1889. The invention consists in the combination, with the hanger and conductor, of a metallic ribbon or wire wound around the conductor and hanger and securing the parts together.

417,753. Time-Distributor for Electric Clocks; Louis H. Spellier, of Philadelphia, Pa., Assignor to the Spellier Electric Time Company, of same place. Application filed Nov. 27, 1888. In a time distributor, the combination of a power-driven shaft, a stopping and releasing device for the shaft, having a master clock for controlling the stopping and releasing devices, and a device for overcoming the inertia of the shaft.

417,758. Automatic Circuit Closer; John Von Der Kammer, of New York, N. Y., Assignor of one-half to James Ward Packard, of same place. Application filed April 25, 1889. In an automatic circuit closer for shunt circuits, the combination of the bifurcated spring, which forms one terminal of the open shunt circuit, the recessed piece, which forms the other terminal, and suitable fusible material by which the branches of the bifurcated spring are held together and out of contact with the recessed piece until the fusible material is melted by the passage of the spark.

417,763. Device for Demagnetizing Watches; Francis J. Whilton, of Boston, Mass. Application filed October 14, 1889. The combination of a rotary shaft, a magnet connected therewith, a guard plate disposed opposite the poles of the magnet, and a support for the guard plate.



No. 418,125.—Electric Synchronizing Device for Clock Pendulums.

417,787. Incandescent Lamp Socket; James Ward Packard, of New York, N. Y., Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed April 25, 1889. In an incandescent lamp socket, the combination with the double spring-operated cut-out, which consists of two separate and mechanically independent branches, a cut-out plug, which normally holds one spring operated branch cut-out out of operation, and a projection upon the lamp which holds the other spring-operated branch cut-out out of operation when the lamp is in the socket.

417,788. Incandescent Lamp Socket; James Ward Packard, of New York, N. Y., Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Sept. 7, 1889. In an incandescent electric lamp socket, the combined double contact spring and circuit closer, which consists of the U-shaped contact spring through which electrical connection is made from one electrode of the lamp to one binding post when the lamp is in the socket, and the corresponding U-shaped circuit closing spring, together with the independent mechanical connections between the corresponding branches of the U-shaped springs which, when the pressure of the lamp upon the contact spring is released by the removal of the lamp from the socket, permit the circuit closing spring to rise and close the circuit between the binding posts.

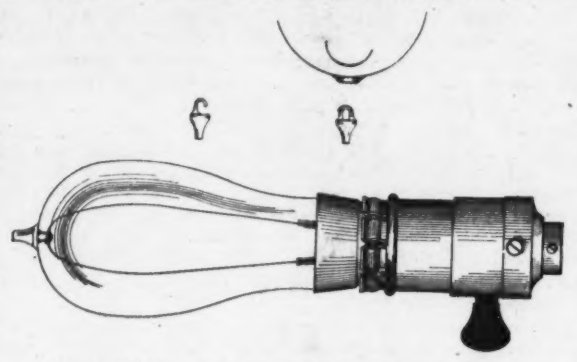
417,789. Incandescent Electric Lamp; James Ward Packard, of New York, N. Y., Assignor to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed Sept. 7, 1889. In an incandescent electric lamp, a lamp bulb which has one or more supporting hooks for the carbon filament, a filament which rests loosely in the supporting hooks, and which has a greater cross section at the point of support and for a short distance on either side than it has throughout other portions of its loop. See illustration.

417,794. Armature for Electric Machines; Albert Schmid, of Allegheny, and Nikola Tesla, of Pittsburgh, Assignors to the Westinghouse Electric Company, of Pittsburgh, Pa. Application filed June 28, 1889. The invention consists, in forming an armature core which is preferably built up of laminæ of magnetizable material insulated from each other, with diverging slots or openings for receiving the armature wire or ribbon, which slots are connected with the exterior of the armature by openings through which the wire may be laid in the slots, and in placing the wire in the proper manner.

* Through an error in our last issue, this patent was designated as "expired."—Eds. E. W.

417,814. Galvanic Battery; Patrick B. Delany, of New York, N. Y. Application filed Sept. 16, 1889. In a battery cell, the combination of the zinc electrode enveloped in a sheath or cover having an opening or openings for the free access of the battery fluid to the top of the zinc.

417,842. Device for an Electric Car-Signal; John P. Runkel, of Milwaukee, Wis. Application filed Feb. 19, 1889. The combination, with a car, a sliding bar secured thereto on the under side, and an actuating spring of a signal wire, a metal plate, to which the wire is connected, and a head, having a longitudinal face, the longitudinal faces of the heads of the plates at the two ends of the car being located at an angle to each other, so that when the heads on two cars come together they will meet each other at right angles.

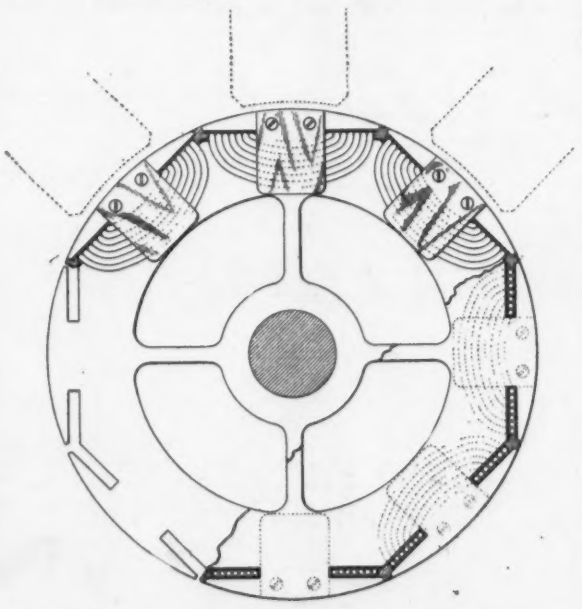


No. 417,789.—Incandescent Electric Lamp.

417,920. Electric Heating Apparatus for Electric Railways; Rudolph M. Hunter, of Philadelphia, Pa., Assignor to the Electric Car Company of America, of same place. Application filed May 9, 1889. The combination of a suspended conductor, an electrically propelled vehicle, a current collector extending from the vehicle to the suspended conductor, a secondary battery on the vehicle and a circuit including the battery and stove receiving current from the current collector.

417,923. Electro Therapeutic Apparatus; Frederick J. Kneuper, of New York, N. Y., Assignor to Emilie Louise Kneuper and Charles G. Willing, of same place. Application filed Jan. 19, 1889. In a pocket battery for therapeutic purposes, a coil having a core consisting of a series of independent parallel soft iron wires insulated from each other and having a soft iron disc at one end and a non-magnetic disc beyond the outer face thereof.

417,926. Electric Circuit Controller; Frederic A. Lane, of New Haven, Conn., Assignor of one-half to Frank E. Morgan, of same place. Application filed April 29, 1889. The combination of a magnet, its armature lever, an electric circuit through the magnet, a circuit breaker arranged in the magnet circuit, a clock work, one of its arbors provided with a toothed ratchet, a lever hung upon the arbor carrying a pawl adapted to engage the ratchet, the said ratchet lever extending into the path of the armature lever, and whereby under the movement of the armature lever a vibratory movement will be imparted to the ratchet lever, a power applied to the ratchet lever in opposition to the armature lever, a second circuit through the clock work independent of the first circuit, a circuit breaker in said second circuit and adapted to be operated by the clock work, with one or more signaling devices in the second circuit.



No. 417,794.—Armature for Electric Machines.

417,927. Automatic Clock Winding Device; Frederick A. Lane, of New Haven, Conn., Assignor of one half to Frank E. Morgan, of same place. Application filed May 24, 1889. The invention consists in combining with the movement of a clock a spring drum arranged upon one of the arbors, a contact revolving with one of the arbors of the clock movement, a stationary contact insulated from the movement, but in the path of the revolving contact, a magnet in the circuit with the stationary contact through the movement, a lever arranged to impart winding rotation to the drum under the action of the armature of the magnet when the circuit is closed, the lever carrying a contact normally in engagement with a second stationary contact in the circuit, but adapted to escape from the second stationary contact under the winding movement imparted to the lever.

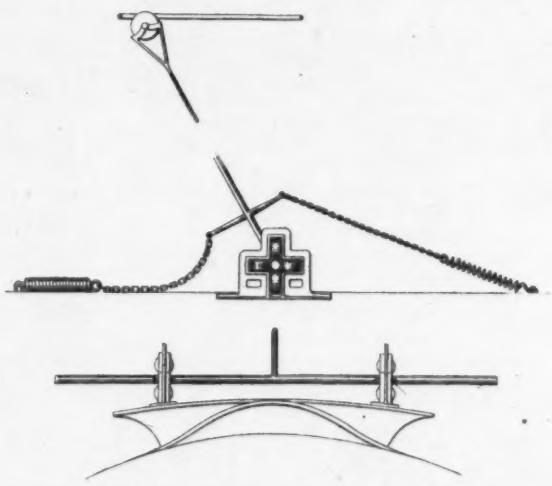
417,928. Electric Winding Clock; Frederic A. Lane, of New Haven, Conn., Assignor of one-half to Frank E. Morgan, of same place. Application filed Sept. 9, 1889. The invention consists in combining with the movement of a clock a spring drum arranged upon one of the arbors, a contact revolving with one of the arbors of the clock movement, a stationary contact insulated from the movement, but in the path of the revolving contact, a magnet in the circuit with the stationary contact, a magnet in the circuit with the stationary contact through the movement, a lever arranged to impart winding rotation to the drum under the action of the armature of the magnet when the circuit is closed, the lever carrying a contact normally in engagement with a second stationary contact in the circuit, but adapted to escape from the second stationary contact under the winding movement imparted to the lever.

417,974. Electric Railway Contact; Francis O. Blackwell, of New York, N. Y. Application filed July 5, 1889. The invention consists in providing a rod or arm extending upwardly from the car, with a traverse slide at its lower end, permitting it to move from side to side of the car as the irregularities in the supply-wire may necessitate. See illustration.

417,992. Underground Electric Conduit; John Dell, of St. Louis, Mo. Application filed Aug. 20, 1889. A conduit for electric wires, made of earthy material and having a central passage polygonal in transverse section, with walls extending radially from the angles of the central passage to the outer wall of the conduit.

417,998. Trolley; William Le Roy Emmet, of Wichita, Kansas. Application filed Sept. 12, 1889. The combination, with the fixed plates, of a tube held between the plates and a contact roller on the tube independent of the plates and free to revolve on the tube.

418,041. Magnetic Rubber Stock Cleaner; Nathaniel C. Mitchell, of Philadelphia, Pa. Application filed Sept. 20, 1889. According to this invention the mass to be treated is fed from a chute across a series of three permanent magnets, and afterward through the field of an electromagnet, the magnets being arranged one above another. By these means the metallic particles are arrested, and they are removed and collected by wipers, which travel continually across the faces of the magnets. The magnets are all inclosed in a casing which is practically air-tight, and at the upper part of this chamber is arranged a large pipe having a flaring mouth, the pipe being provided with an exhaust fan, by means of which the fine particles of dust in the rubber are sucked out.



No. 417,974.—Electric Railway Contact.

418,120. Magneto-Electric Machine; Webster Gillette, of New York, N. Y., Assignor to C. F. Gillette, of same place. Application filed June 23, 1886. Renewed May 4, 1889. In a magneto-electric machine, the combination, with a permanent magnet consisting of circular plates provided with pole pieces composed of plates nearly semicircular in form and having their square ends substantially parallel with and close to the corresponding ends of the opposite pole piece, of an armature having central transverse trunnions, a plate bolted to the lower plate of the field magnet and supporting the lower trunnion of the armature, and a frame extending over the top of the field magnet and bolted to the upper plate thereof to give bearing to the upper trunnion.

418,125. Electric Synchronizing Device for Clock Pendulums; James Hamblet, of Brooklyn, New York. Application filed March 7, 1889. A synchronizing device for clock pendulums, consisting of an electro magnet having inwardly projecting pole pieces, and an armature attached to the pendulum arranged to pass between the pole pieces at each beat. See illustration.

418,140. Electrode for Secondary Batteries; Harry Gould Osburn, of Chicago, Ill. Application filed Aug. 23, 1889. In an electric secondary battery, a metal conductor plate having gutters made in the bars bounding the sides of the perforations therein, which are upset so as to form fins, which lap over the edges of the perforations and confine the active material previously placed therein.

PATENTS EXPIRED DEC. 24, 1889.

134,140. Improvement in Electric Telegraphs; Henry Highton, of Putney, England. A telegraph receiving apparatus consisting essentially of a strip of gold leaf connected with two metallic conductors and arranged within the influence of a magnet.

134,246. Improvement in Circuits for Railroad Signals; Robert K. Boyle, of Brooklyn, N. Y. The combination with intermitted rail sections, extra rails or extension devices, extended from one intermitted section beyond the intermission between it and the next section.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address The W. J. Johnston Co. Ltd., Times Building, N. Y.

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With an order from Daniel Shaw Lumber Co. Eau Claire, Wis., dated June 16, 1888 they say: The dynamo belt sent us is a "Jim Dandy."